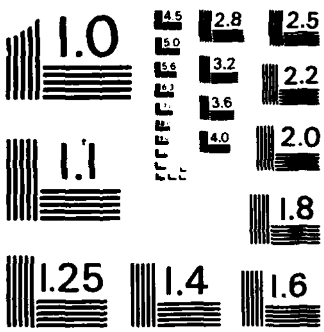
AD-A169 700   ASPHALT-RUBBER SAMI (STRESS-ABSORBING MEMBRANE   1/2
INTERLAYERS) FIELD EVALUAT..(U) NEW MEXICO ENGINEERING
RESEARCH INST ALBUQUERQUE R G MCKEEN ET AL. APR 86
UNCLASSIFIED   NMERI-WA5-7(5.06) AFESC/ESL-TR-86-02   F/G 13/3   NL


1.0
4.5
5.0
5.6
6.3
2.8
3.2
3.6
4.0
2.5
2.2
2.0
1.1
1.8
1.25
1.4
1.6

ESL-TR-86-02

Asphalt–Rubber SAMI Field Evaluation

R. GORDON McKEEN
RAYMOND D. PAVLOVICH
VINCENT CASSINO

NEW MEXICO ENGINEERING RESEARCH INSTITUTE
BOX 25
UNIVERSITY OF NEW MEXICO
ALBUQUERQUE, NEW MEXICO
87131

FINAL REPORT

APRIL 1986

OCTOBER 1984-SEPTEMBER 1985

APPROVED FOR PUBLIC RELEASE: DISTRIBUTION UNLIMITED

AIR FORCE ENGINEERING AND SERVICES CENTER

AFESC

ENGINEERING & SERVICES LABORATORY
AIR FORCE ENGINEERING & SERVICES CENTER
TYNDALL AIR FORCE BASE, FLORIDA 32403

NOTICE

PLEASE DO NOT REQUEST COPIES OF THIS REPORT FROM HQ AFESC/RD (ENGINEERING AND SERVICES LABORATORY). ADDITIONAL COPIES MAY BE PURCHASED FROM:

NATIONAL TECHNICAL INFORMATION SERVICE
5285 PORT ROYAL ROAD
SPRINGFIELD, VIRGINIA 22161

FEDERAL GOVERNMENT AGENCIES AND THEIR CONTRACTORS REGISTERED WITH DEFENSE TECHNICAL INFORMATION CENTER SHOULD DIRECT REQUESTS FOR COPIES OF THIS REPORT TO:

DEFENSE TECHNICAL INFORMATION CENTER
CAMERON STATION
ALEXANDRIA, VIRGINIA 22314

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION
Unclassified

1b. RESTRICTIVE MARKINGS

2a. SECURITY CLASSIFICATION AUTHORITY

2b. DECLASSIFICATION/DOWNGRADING SCHEDULE

3. DISTRIBUTION/AVAILABILITY OF REPORT
Approved for Public Release, Distribution Unlimited.

4. PERFORMING ORGANIZATION REPORT NUMBER(S)
NMERI WA5-7 (5.06)

5. MONITORING ORGANIZATION REPORT NUMBER(S)
ESL-TR-86-02

6a. NAME OF PERFORMING ORGANIZATION
New Mexico Engineering Research Institute

6b. OFFICE SYMBOL *(If applicable)*
NMERI

7a. NAME OF MONITORING ORGANIZATION
Engineering and Services Laboratory

6c. ADDRESS *(City, State and ZIP Code)*
Box 25, University of New Mexico
Albuquerque, New Mexico 87131

7b. ADDRESS *(City, State and ZIP Code)*
Air Force Engineering and Services Center
Tyndall Air Force Base, Florida 32403

8a. NAME OF FUNDING/SPONSORING ORGANIZATION

8b. OFFICE SYMBOL *(If applicable)*

9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
Contract No. F29601-84-C-0080

8c. ADDRESS *(City, State and ZIP Code)*

10. SOURCE OF FUNDING NOS.

PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.	WORK UNIT NO.
PE64708F	2054	4P	29

11. TITLE *(Include Security Classification)*
ASPHALT-RUBBER SAMI FIELD EVALUATION

12. PERSONAL AUTHOR(S)
R. Gordon McKeen, Raymond D. Pavlovich, and Vincent Cassino

13a. TYPE OF REPORT
Final Report

13b. TIME COVERED
FROM 10/29/84 TO 9/30/85

14. DATE OF REPORT *(Yr., Mo., Day)*
April 1986

15. PAGE COUNT
154

16. SUPPLEMENTARY NOTATION
Availability of this report is specified on reverse of front cover.

Keywords:

17. COSATI CODES

FIELD	GROUP	SUB. GR.
11	07	

18. SUBJECT TERMS *(Continue on reverse if necessary and identify by block number)*
Airfield parameters, Field observations,
Asphalt-rubber, Reflection cracking,
Performance monitoring, (OVER)

19. ABSTRACT *(Continue on reverse if necessary and identify by block number)*

This report documents the investigation of asphalt-rubber mixtures for use as stress-absorbing membrane interlayers (SAMIs) for airfield pavements. The project was initiated in 1977 as a state-of-the-art review (Reference 1). That study concluded that use of SAMIs was promising for improving the performance of asphalt-concrete overlays on airfield pavements. A following study addressed material characterization and development of a proposed construction specification (Reference 2). This report covers follow-on monitoring of the performance of an experimental pavement project at Kirtland AFB, Apron A: construction and performance monitoring of two trial sections located at Williams AFB and Coolidge Field in Arizona; and the design and construction of a field experiment at Peterson AFB, Colorado. Based on the results obtained to date, the performance observed cannot be related in a meaningful way to the material characteristics. This results from the small time elapsed since construction of the pavements under observation. Based on experience, a (OVER)

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT
UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☒ DTIC USERS ☐

21. ABSTRACT SECURITY CLASSIFICATION
Unclassified

22a. NAME OF RESPONSIBLE INDIVIDUAL
James Murfee

22b. TELEPHONE NUMBER *(Include Area Code)*
(904) 283-6322

22c. OFFICE SYMBOL
RDCP

DD FORM 1473, 83 APR

EDITION OF 1 JAN 73 IS OBSOLETE.

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE

18. SUBJECT TERMS (CONCLUDED)

Stress-absorbing membrane-interlayers (SAMIs)

19. ABSTRACT (CONCLUDED)

revised proposed construction specification is included in the current report. Continued performance monitoring is recommended in order to obtain the benefit from the investment made in the initial construction documentation.

FLD18

PREFACE

This report was prepared by the New Mexico Engineering Research Institute (NMERI), University of New Mexico at the Eric H. Wang Civil Engineering Research Facility, Kirtland Air Force Base, New Mexico, under Contract F29601-84-C-0080, Job Order 2054-4P29, for the Engineering and Services Laboratory, Headquarters, Air Force Engineering and Services Center, Tyndall Air Force Base, Florida 32403-6001.

This report summarizes work performed between October 1984 through September 1985. Mr James G. Murfee was the AFESC/RDCP Project Officer.

This report covers follow-on monitoring of the performance of pavement projects documented in ESL-TR-83-50, Development of Criteria for the Use of Asphalt-Rubber as a Stress-Absorbing Membrane Interlayer (SAMI), by Newcomb and McKeen.

This report has been reviewed by the Public Affairs Office and is releasable to the National Technical Information Service (NTIS). At NTIS, it will be available to the general public, including foreign nations.

This technical report has been reviewed and is approved for publication.

JAMES G. MURFEE
Project Officer

Robert E. Boyer
ROBERT E. BOYER, Col, USAF
Director, Engineering and Services Laboratory

Everett L. Mabry
EVERETT L. MABRY, Lt Col, USAF
Chief, Engineering Research Division

Accesion For	
NTIS CRA&I	☑
DTIC TAB	☐
Unannounced	☐
Justification	
By	
Distribution /	
Availability Codes	
Dist	Avail and / or Special
A-1	

QUALITY INSPECTED 1

(The reverse of this page is blank.)

TABLE OF CONTENTS

Section	Title	Page
I	INTRODUCTION	1
	A. OBJECTIVE	1
	B. BACKGROUND	1
	C. SCOPE	2
II	ASPHALT-RUBBER MATERIALS	3
III	KIRTLAND AFB, APRON A FIELD TRIAL	4
IV	ARIZONA TEST SECTIONS	7
V	PETERSON AFB, FIELD TRIAL	24
	A. OBJECTIVES	24
	B. LOCATION	24
	C. DESIGN OF THE EXPERIMENT	25
	D. SEQUENCE OF EVENTS FOR PAVING OPERATIONS	26
VI	CONCLUSIONS AND RECOMMENDATIONS	29
	A. APRON A, KIRTLAND AFB	29
	B. WILLIAMS AFB/COOLIDGE FIELD	31
	C. PETERSON AFB	31
	D. SPECIFICATIONS	31
	E. RECOMMENDATIONS	32
	REFERENCES	33
APPENDIX		
A	DD FORM 1391C FOR ARIZONA PROJECTS	35
B	SPECIFICATIONS FOR ARIZONA PROJECTS	45
C	DATA REDUCTION AND ANALYSIS--PETERSON AFB	53
D	APPLICABLE SPECIFICATION SECTIONS--PETERSON AFB	87
E	TYPICAL FIELD DATA SHEETS--PETERSON AFB	143
F	CONSTRUCTION DATA--PETERSON AFB	149

LIST OF ILLUSTRATIONS

Figure	Title	Page
1	Runway 12L-30R, Williams AFB, Arizona	8
2	Coolidge Airport Runway, Arizona	9
3	Existing Cracking at Williams AFB Before Overlay	17
4	Existing Cracking at Coolidge Airport Before Overlay	18
5	Existing Cracking at Williams AFB, November 3, 1984	19
6	Existing Cracking at Williams AFB, July 6, 1985	20
7	Existing Cracking at Coolidge Airport, November 2, 1984	21
8	Existing Cracking at Coolidge Airport, July 5, 1985	22
9	Cracking Index Data for Apron A	30
10	Percent Cracking Data for Arizona Sites	30

LIST OF TABLES

Table	Title	Page
1	APRON A TEST VARIABLES	5
2	RELATIVE CRACKING DATA FOR APRON A	6
3	WILLIAMS AFB BATCH DATA	10
4	COOLIDGE AIRPORT BATCH DATA	11
5	DATA FOR SAMPLES FROM WILLIAMS AFB	13
6	DATA FOR SAMPLES FROM WILLIAMS AFB	14
7	DATA FOR SAMPLES FROM COOLIDGE AIRPORT	15
8	DATA FOR SAMPLES FROM COOLIDGE AIRPORT	16
9	RESULTS OF EVALUATION AT ARIZONA SITES	23
10	EXPERIMENTAL MATERIALS--PETERSON AFB	25

SECTION I
INTRODUCTION

A. OBJECTIVE

The objective of this study was the evaluation of asphalt-rubber mixtures for use in the design, construction, and maintenance of airfield pavements to prevent or retard the development of fatigue and reflective cracking in these pavements and, thereby, extend their service life.

B. BACKGROUND

The idea of using a combination of asphalt and rubber in pavement construction is not a recent innovation. Samuel J. Whiting was awarded a U.S. patent in 1873 for an asphalt paving mixture containing 1 percent balata. A German patent was issued to Charles de Caudemberg of Nice, France in 1899 for rubberizing pavement. The earliest documented asphalt-rubber pavement construction took place in Cannes, France in 1902. Since these early experiences with asphalt and rubber combinations, numerous patents have been issued for various applications of asphalt-rubber.

An asphalt-rubber seal coat was developed by Charles H. McDonald while he was Engineering Supervisor for Phoenix, Arizona. This product was successful in providing a durable wearing surface for pavements with severe alligator cracking. Further research with this process revealed that there was promise in using the material as an interlayer to prevent the reflection of cracks from an old pavement to a new asphalt-concrete overlay. The asphalt-rubber seal coat concept is commonly referred to as a stress-absorbing membrane (SAM) and the interlayer concept is called a stress-absorbing membrane interlayer (SAMI).

McDonald's method involved combining up to 33 percent ground, reclaimed tire rubber in asphalt to absorb direct tensile, flexural, and shearing stresses. Since McDonald developed the material in the mid-1960s, a number of studies have been conducted on construction procedures and field performance as well as laboratory evaluations. Efforts have also been made to relate asphalt-rubber properties to the reduction of crack propagation in pavement

systems. A thorough discussion of the work described here and pertinent references are documented in previous reports (Reference 1 and 2).

Recognizing the potential benefits of asphalt-rubber mixtures in pavement systems, the Air Force Engineering and Services Center (AFESC) decided to initiate a technology review of the material in April 1977 (Reference 2). Two of the conclusions made in this study were (1) that asphalt-rubber mixtures seem promising in the prevention of reflection cracking, and (2) that asphalt-rubber interlayers should be investigated in conjunction with conventional asphalt-concrete overlays.

An investigation was funded to investigate the physical properties of asphalt-rubber materials and study, by field experiments, their relation to performance. The major portion of that study was previously reported (Reference 2). Following that work the field experiment at Apron A, Kirtland AFB, New Mexico was surveyed, two monitoring sections were established at William AFB and Coolidge Field in Arizona (Reference 3), and a field experiment was designed and constructed at Peterson AFB, Colorado. These latter activities are the subject of the present report.

C. SCOPE

This research effort consisted of performing crack surveys at Apron A, Kirtland AFB to document field performance. Preconstruction surveys were made at the Williams and Coolidge sites. Asphalt-rubber samples were taken and tested and construction activities were documented. The performance has been monitored by conducting crack surveys since construction. A new site was identified at Peterson AFB and the preconstruction survey completed, as well as the design of a field experiment. The project was completed and construction documented. Some sampling was completed but no testing was included as part of this study. No performance surveys have been made at Peterson AFB. A revised construction specification for asphalt-rubber SAMIs is included in the report.

SECTION II

ASPHALT-RUBBER MATERIALS

Asphalt and rubber are combined in several ways and used as pavement components for different purposes. Six classifications have been identified (Reference 4):

1. Asphalt-Rubber Seal Coat
2. Asphalt-Rubber Interlayer
3. Asphalt-Rubber Concrete
4. Asphalt-Rubber Friction Coarse
5. Asphalt-Concrete Rubber-Filled
6. Friction Coarse Rubber-Filled

This report is primarily concerned with the asphalt-rubber interlayer. Detailed descriptions of the material and literature reviews were previously published (References 1 and 2). The other materials listed above are outside the scope of the study.

Two procedures for preparing the material are in use and are described specifically in Appendix D, Section D-2 as Method A and Method B. No evidence exists to justify a preferred method. Both processes involve (1) combining ground rubber with hot asphalt cement, (2) mixing and permitting reactions to occur, and (3) applying to the surface with a special distributor followed by application of chips. When covered with an overlay, the material is expected to transfer vertical and shear loads, primarily through the chip interaction with the asphalt concrete layers above and below. The low modulus asphalt-rubber material is believed to dissipate the high stresses associated with crack propagation through pavement layers. This reduction of stress then either retards or eliminates propagation of existing cracks through the overlay material. A satisfactory behavior model for use in studying this problem is not presently available. Therefore, it is not possible to study variations in properties and make reliable predictions of expected performance using a theoretical model. A comprehensive program of material property measurement was previously reported (Reference 2). In the future it may be possible to relate these characteristics to performance.

SECTION III

KIRTLAND AFB, APRON A FIELD TRIAL

The New Mexico Engineering Research Institute (NMERI) designed an experiment to include several mix parameters for a construction project at Apron A, Kirtland AFB. The existing apron was an old asphalt-concrete pavement approximately 3.8 cm (1.5 inches) thick. The pavement was badly deteriorated due primarily to environmental factors. Experimental sections included the variables shown in Table 1. Complete documentation of the construction is presented in Reference 2. A 7.6-cm (2-inch) overlay was placed on the SAMI. Condition evaluations have been made at roughly 6-month intervals since construction. Evaluations made in November 1981 and May 1982 revealed no cracking. In November 1982 at 1 year of age, 20 cracks were found, all in the control section. Results of later surveys are presented in Table 2 as relative cracking values.

The use of Apron A was limited to very little traffic until February 1983. During this month, approximately 30 F-16 aircraft conducted two training missions per day, using Apron A. Shortly afterwards, the Kirtland Base Operations activity moved, changing the parking area for Kirtland military transient aircraft. As of the July 1985 evaluation, virtually all military aircraft except heavy cargo planes are using Apron A to get to the parking apron. Also of importance is that commercial traffic was diverted to the east end of the main runway for an indefinite period around February 1985. As a result, SAMI sections designated 1-2-1, 1-2-2, 1-1-1, and 1-1-2 received traffic from B737, B727, and other commercial aircraft.

Data in Table 2 were evaluated to determine what hypotheses might be tested. Note that the first control section of all new asphalt-concrete (AC) has been subjected to heavy fuel-truck traffic, resulting in numerous cracks. Contrast this with the other control section which did not carry truck traffic. Data are evaluated and discussed in Section VI.

TABLE 1. APRON A TEST VARIABLES

VARIABLE	VALUES INCORPORATED IN TEST
Rubber Type	TPO 44, Auto tire tread, ambiently ground C-104, Whole tire, ambiently ground CPR-10P, whole tire, cryogenically ground
Mixing Time	0.25 hour, 1.0 hour, 3.7 hours
Surface Preparation	Heater scarifier (HS) Slurry seal

TABLE 2. RELATIVE CRACKING DATA FOR APRON A

SECTION	RELATIVE CRACKING[a] AT AGES, linear meters/10,000 m^2 (linear feet/10,000 ft^2)					
Control Sections[b]	1	1.5	2.2	2.6	3.2	3.6
14 cm (5.5 inches) of AC	30.5 (9.3)	37.1 (11.3)	168.0 (51.3)	178.0 (54.2)	182.0 (55.4)	199.0 (60.6)
7.6 cm (3 inches) of AC on 3.8 cm (1.5 inches) HS	0 (0)	0 (0)	16.4 (5.0)	16.4 (5.0)	37.4 (11.4)	0 (0)
SAMI Sections[c]						
3-3-1	0 (0)	8.9 (2.7)	33.5 (10.2)	84.6 (25.8)	105.0 (32.0)	105.0 (32.1)
3-2-1	0 (0)	9.5 (2.9)	15.4 (4.7)	25.6 (7.8)	4.3 (1.3)	8.9 (2.7)
3-1-1	0 (0)	6.9 (2.1)	7.2 (2.2)	7.2 (2.2)	7.5 (2.3)	12.5 (3.8)
2-3-1	0 (0)	21.0 (6.4)	46.6 (14.2)	38.1 (11.6)	37.7 (11.5)	19.0 (5.8)
2-2-1	4.3 (1.3)	3.3 (1.0)	19.0 (5.8)	10.2 (3.1)	16.4 (5.0)	0 (0)
2-1-1	0 (0)	4.6 (1.4)	10.2 (3.1)	15.4 (4.7)	9.5 (2.9)	5.25(16.0)
1-3-1	17.1 (5.2)	22.0 (6.7)	66.9 (20.4)	82.3 (25.1)	50.2 (15.3)	53.8 (16.4)
1-2-1	4.9 (1.5)	5.2 (1.6)	26.2 8.0	66.9 (20.4)	210.0 (64.0)	129.0 (39.2)
1-1-1	0 (0)	0 (0)	3.0 0.9	17.4 (5.3)	104.0 (31.6)	8.9 (2.7)

[a]Relative cracking is total length of cracking (excluding construction joints) divided by total area of test sections.

[b]Control sections are 167.6 m (550 ft) by 25.9 m (85 ft), yielding an area of 4343 m^2 (46,750 ft^2).

[c]SAMI sections are designated as follows:

1st digit--rubber type: 1 = TPO 44; 2 = C104; 3 = CPR-10P

2nd digit--mix time: 1 = 0.25 hour; 2 = 1.0 hour; 3 = 3.7 hours

3rd digit--surface preparation: 1 = heater scarify (HS); 2 = slurry seal

SECTION IV

ARIZONA TEST SECTIONS

In 1983 the 82nd ABG stationed at Williams AFB, Arizona initiated Project No. WI-83-1365(521) to maintain and overlay runway 12L-30R at Williams AFB and Project No. WI-83-1580 to maintain and overlay runway 5-23 at the Coolidge-Florence Municipal Airport. The Coolidge site is used as an auxiliary field for training missions from Williams AFB. Appendix A contains information from DD Form 1391C, Military Construction Project Data, for the sites. The projects were similar, calling for repair of the existing surface, leveling, SAMI placement, and construction of a 3.8 cm (1.5-inch) asphalt-concrete overlay. Both sites exhibited block cracking and were beginning to deteriorate, causing foreign object damage (FOD) hazards to user aircraft. Typical examples of the preconstruction conditions for each site are shown in Figures 1 and 2.

The general contractor was Ireland Contracting Company, Inc. Asphalt-rubber was furnished and placed by Arizona Refining Company (ARCO). Benson and Gerdin, Inc. performed quality control and construction monitoring. All of these organizations are located in the Phoenix, Arizona area. The asphalt-rubber specification is included in Appendix B. Asphalt-rubber furnished was ARM-R-SHIELD* meeting Production Specification No. M101-83, also shown in Appendix B. The government pemitted departure from the original specification to allow this material and create a competitive bid situation. The procedure for manufacture and placement of the material is shown in Appendix B. SAMI construction took place December 13, 14, and 15, 1983 at Williams AFB, and on January 18, 19, and 20, 1984 at Coolidge Field.

NMERI became involved in the project after the construction package was completed and put out for bids. Therefore,no opportunity to design a field experiment existed. It was decided to establish test sections at each site for the purpose of monitoring the rate of development of cracking in the new overlay. During construction, NMERI monitored material temperature and construction procedures and obtained samples for laboratory testing. All laboratory tests were performed at the NMERI facilities located in Albuquerque, New Mexico.

---

*Trademark of Arizona Refining Co., Inc.

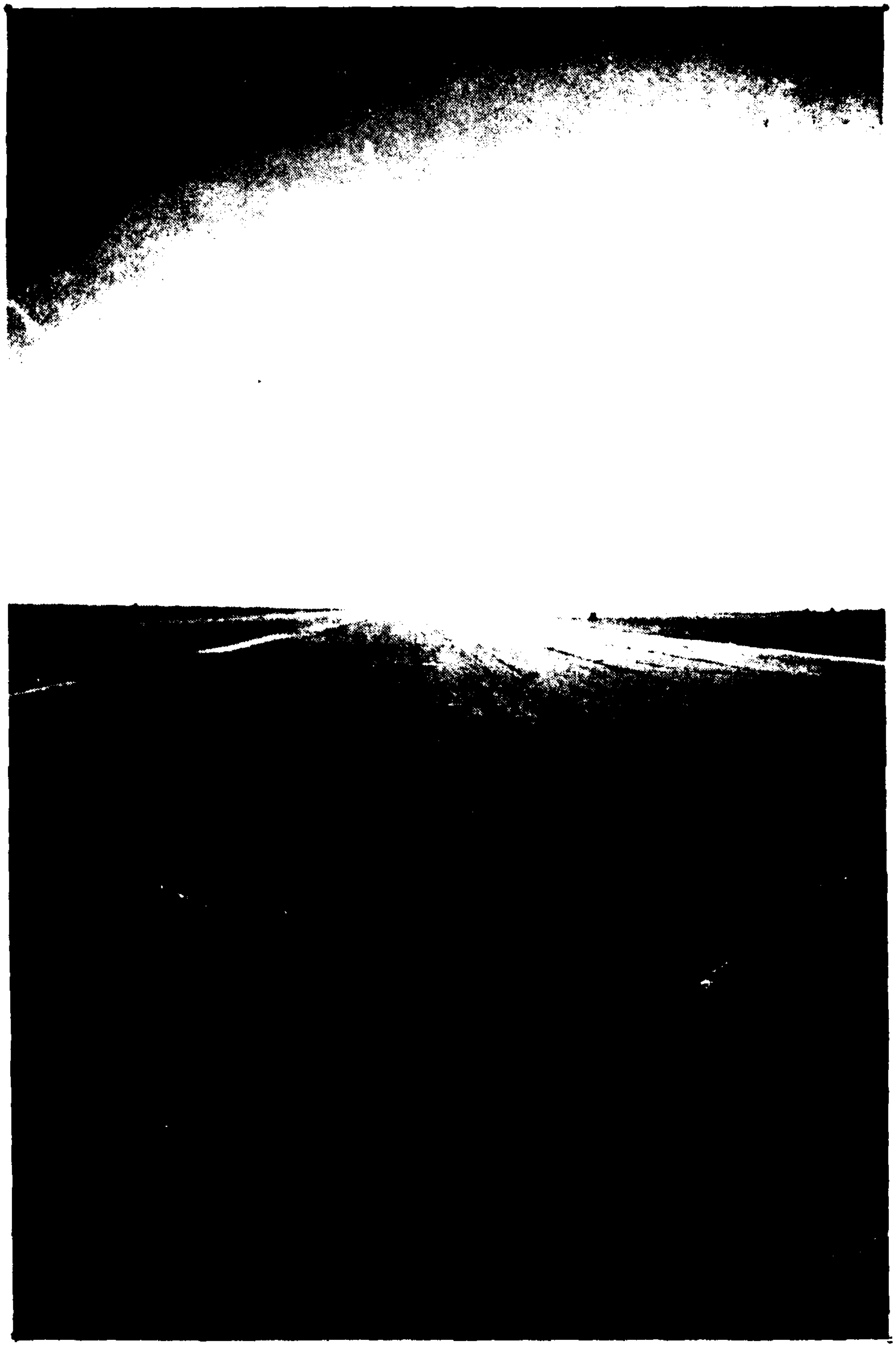


Figure 1. Runway 12L-30R, Williams AFB, Arizona (before construction).

Figure 2. Coolidge Airport Runway, Arizona (before construction).

The Williams AFB test section was located on the north end of runway 12L-30R, 83.8 meters (275 feet) south of the portland cement concrete (PCC) runway end. About two-thirds of the test section was milled from a 0- to 0.6-cm (0.25-inch) depth as part of the transition to the PCC runway end. The SAMI was placed in 12 passes starting at the west pavement edge, going north, and then alternating across the width of the runway. A total of seven batches of material were prepared as shown in Table 3. Construction of the SAMI proceeded as planned and no significant deviation from the contract specifications were observed. Note that the Arizona Refining Company standard product does not meet the original project specification. This was altered by a change order to allow the ARCO material, thereby, producing a competitive situation. The percent rubber in the mixture was the only departure required.

TABLE 3. WILLIAMS AFB BATCH DATA

BATCH	TRUCK	DATE/ TIME	PASS	MIX TEMPERATURE, °F	WIND, mi/h	HUMIDITY, %	TEMPERATURE AIR, °F	TEMPERATURE PVMT., °F
---	---	12-13	---	---	4	25-30	58-54	62-80
W1	821	1:15 p.m.	1,2	390	---	---	---	---
W2	821	4:20 p.m.	3	380	---	---	---	---
W3	822	4:40 p.m.	4	370	---	---	---	---
---	---	12-14	---	---	6	31	50-65	70-82
W4	792	10:45 a.m.	5,6	400	---	---	---	---
W5	822	2:00 p.m.	7,8	390	---	---	---	---
---	---	12-15	---	---	8	76	52-60	66-85
W6	792	9:45 a.m.	9,10	400	---	---	---	---
W7	802	12:35 p.m.	11,12	385	---	---	---	---

The Coolidge Field test section was laid out in the interior of runway 5-23. An attempt was made to seal the cracks prior to SAMI placement using a CSS-1 asphalt emulsion. This was then covered with sand. The result was that cracks were not sealed and sand was all over the area, being blown around by the wind and truck traffic on the pavement. A total of eight batches of material were used, being placed in 12 passes. The passes began at the west pavement edge going south and alternated across the pavement. Data are shown in Table 4 pertaining to the construction period. In some cases the emulsion contributed to excessive amounts of asphalt cement bleeding through the chips used to cover the asphalt-rubber.

TABLE 4. COOLIDGE AUXILIARY FIELD BATCH DATA

BATCH	TRUCK	DATE/ TIME	PASS	MIX TEMPERATURE, °F	WIND, mi/h	HUMIDITY, %	TEMPERATURE	
							AIR, °F	PVMT., °F
---	---	1-18	---	nd[a]	nd	nd	50	60
C1	792	10:45 a.m.	1	---	---	---	---	---
---	---	1-19	---	---	0-10	nd	40-55	---
C2	822	10:30 a.m.	2,3	395	---	---	---	---
C3	802	1:10 p.m.	4,5	390	---	---	---	---
C4	792	3:45 p.m.	6,7	400	---	---	---	---
---	---	1-20	---	---	5	nd	45	40-52
C5	792	11:00 a.m.	8	400	---	---	---	---
C6	802	11:40 a.m.	9	nd	---	---	---	---
C7	822	1:30 p.m.	10,11	405	---	---	---	---
C8	802	4:15 p.m.	12	400	---	---	---	---

[a]no data

Materials sampled from the Williams and Coolidge SAMIs were returned to the NMERI laboratory in Albuquerque for testing. Tests used were the Modified Softening Point Temperature, Constant Pressure (Schweyer) Viscosity, Force-Ductility, and Cone Penetration. All but the cone penetration test are fully described in Reference 2. A description of the cone penetration test is given in Reference 5.

Results of testing are reported in Tables 5 and 6 for Williams AFB and Tables 7 and 8 for Coolidge Airport following the format of the previous report (Reference 2). The scope of testing was reduced in comparison to that completed for the Apron A SAMI materials. Reasons for this were a lack of material property variation from batch to batch and limited funds for support of the laboratory work.

Prior to construction, NMERI documented the existing cracking patterns at both sites, using air photos. These data were manually converted to crack maps, as shown in Figures 3 and 4.

Condition evaluations were conducted at each site in April and November 1984, and July 1985. Ages at the time of evaluation were 0.3, 0.9, and 1.5 years, respectively, for the Williams AFB site and 0.2, 0.8, and 1.4 years, respectively, for the Coolidge site. The initial inspections revealed no cracking or evidence of other distress in either overlay. Cracking was recorded for each site at all other evaluations. These results are shown in Figures 5 and 6 (Williams AFB), and Figures 7 and 8 (Coolidge). Table 9 summarizes results of the evaluations. These data indicate that 75 to 85 percent of the cracking originally in the test sections is reproduced in the overlays after about 1 1/2 years of service. Since no control section was constructed, it is not possible to draw any conclusion about the relative value of the SAMI versus an overlay without the SAMI.

TABLE 5. DATA FOR SAMPLES FROM WILLIAMS AFB

TRUCK NO.	LOG VISCOSITY AT 0.05 s^{-1} AND 60°F			LOG VISCOSITY AT 1.0 s^{-1} AND 60°F			LOG VISCOSITY AT 100 W/m^3 AND 60°F			FLOW PARAMETER, C		
	Mean	n_p	SD	Mean	n_p	SD	Mean	n_p	SD	Mean	n	SD
Week 0												
W1	8.0118	4		7.4091	4		8.7796	4		0.512	4	0.091
W2	8.0263	4		7.4346	4		8.7697	4		0.526	4	0.075
W3	8.0785	4		7.3856	4		8.9805	4		0.465	4	0.019
W4	8.0056	4		7.3400	4		8.8545	4		0.477	4	0.066
W5	8.1761	4		7.5767	4		8.9689	4		0.523	4	0.062
W6	8.0899	4		7.4445	4		8.9122	4		0.503	4	0.015
W7	8.1021	4		7.4553	4		8.9424	4		0.490	4	0.049
Week 3												
W3	8.1798	4		7.5740	4		8.9677	4		0.531	4	0.03
W4	8.0656	4		7.4362	4		8.8525	4		0.516	4	0.02
W6	8.1232	4		7.4757	4		8.9695	4		0.494	4	0.05
W7	8.1553	4		7.4955	4		9.0257	4		0.492	4	0.03
Week 8												
W4	8.0086	4		7.3579	4		8.8343	4		0.479	4	0.07
W7	8.0969	4		7.4314	4		8.9754	4		0.472	4	0.07
Week 28												

TABLE 6. DATA FOR SAMPLES FROM WILLIAMS AFB

TRUCK NO.	MODIFIED SOFTENING POINT TEMPERATURE, °F			COMPLIANCE, $(psi^{-1}) \times 10^{-4}$			WORK, in-lb			CONE PENETRATION, 77°F 5 s 150 g mm x 10^{-1}		
	Mean	n	SD	Mean	n	SD	Mean	n	SD	Mean	n	SD
<u>Week 0</u>												
W1	134	6	0.9	135	6	6.3	21.3	6	1.5	51	3	1.0
W2	133	6	1.7	136	6	4.5	21.5	6	3.5	50	3	0.6
W3	139	6	0.8	86	6	4.0	24.4	6	3.2	45	3	1.5
W4	135	6	0.8	123	6	8.1	22.8	6	3.5	50	3	1.7
W5	140	6	0.8	100	6	5.8	27.1	6	1.8	45	3	2.3
W6	138	6	1.4	98	6	2.3	26.2	6	2.6	42	3	0.6
W7	136	6	1.0	88	6	2.6	29.4	6	2.6	46	3	2.1
<u>Week 3</u>												
W3	142	6	0.5	84	6	4.8	25.2	6	2.3	45	3	1.2
W4	138	6	0.8	122	6	5.6	19.4	6	3.1	47	3	1.2
W6	139	6	2.1	97	6	3.9	26.8	6	2.2	48	3	0.6
W7	139	6	1.9	94	6	3.3	26.5	6	3.3	45	3	1.0
<u>Week 8</u>												
W4	137	6	1.6	120	6	9.6	22.2	6	3.3	51	3	1.0
W7	140	6	1.4	86	6	2.4	29.4	6	1.9	4.6	3	1.0
<u>Week 28</u>												

TABLE 7. DATA FOR SAMPLES FROM COOLIDGE AIRPORT

TRUCK NO.	MODIFIED SOFTENING POINT TEMPERATURE, °F			COMPLIANCE, $(psi^{-1}) \times 10^{-4}$			WORK, in-lb			CONE PENETRATION, 77°F 5 s 150 g mm $\times 10^{-1}$		
	Mean	n	SD	Mean	n	SD	Mean	n	SD	Mean	n	SD
Week 0												
C1	125	6	0.8	195	6	6.8	15.4	6	1.1	67	3	0
C2	124	6	0.8	255	6	9.8	12.3	6	1.4	72	3	1.2
C3	130	6	1.4	158	6	9.1	17.4	6	2.2	64	3	1.0
C4	128	6	1.0	161	6	9.5	17.3	6	3.0	61	3	1.5
C5	126	6	1.4	207	6	6.9	13.7	6	1.4	70	3	0.6
C6	128	6	1.0	185	6	8.8	15.2	6	1.0	66	3	1.2
C7	130	6	0	164	6	5.8	15.5	6	2.9	61	3	1.0
C8	129	6	1.3	184	6	9.8	14.7	6	1.7	69	3	1.0
Week 3												
C2	124	6	2.3	225	6	9.7	15.1	6	1.4	73	3	0
C3	131	6	2.8	147	6	3.0	19.4	6	1.7	63	3	1.5
Week 8												
C2	130	6	1.4	224	6	9.5	13.6	6	1.1	73	3	1.5
C3	126	6	1.5	126	6	3.7	21.5	6	1.7	60	3	2.3
Week 28												

TABLE 8. DATA FOR SAMPLES FROM COOLIDGE AIRPORT

TRUCK NO.	LOG VISCOSITY AT 0.05 s^{-1} AND 60°F			LOG VISCOSITY AT 1.0 s^{-1} AND 60°F			LOG VISCOSITY AT 100 W/m^3 AND 60°F			FLOW PARAMETER, C		
	Mean	n_p	SD	Mean	n_p	SD	Mean	n_p	SD	Mean	n	SD
Week 0												
C1	7.8331	4	0.9808	7.2788	4		7.4425	4		0.568	4	0.046
C2	7.7738	4		7.2175	4		7.3711	4		0.569	4	0.031
C3	7.9315	4		7.3263	4		7.5658	4		0.554	4	0.014
C4	7.8609	4		7.3010	4		7.4942	4		0.557	4	0.050
C5	7.8215	4		7.2945	4		7.3874	4		0.595	4	0.011
C6	7.8248	4		7.2148	4		7.5119	4		0.526	4	0.033
C7	7.9079	4		7.3744	4		7.5453	4		0.566	4	0.089
C8	7.8035	4		7.1673	4		7.5366	4		0.498	4	0.068
Week 3												
C2	7.7372	4		7.1139	4		7.4082	4		0.521	4	0.015
C3	7.9455	4		7.3522	4		7.6405	4		0.542	4	0.017
Week 8												
C2	7.8549	4		7.3010	4		7.4742	4		0.566	4	0.042
C3	7.8567	4		7.2577	4		7.5717	4		0.498	4	0.107
Week 28												

WILLIAMS AFB

Test section on Runway 12L/30R

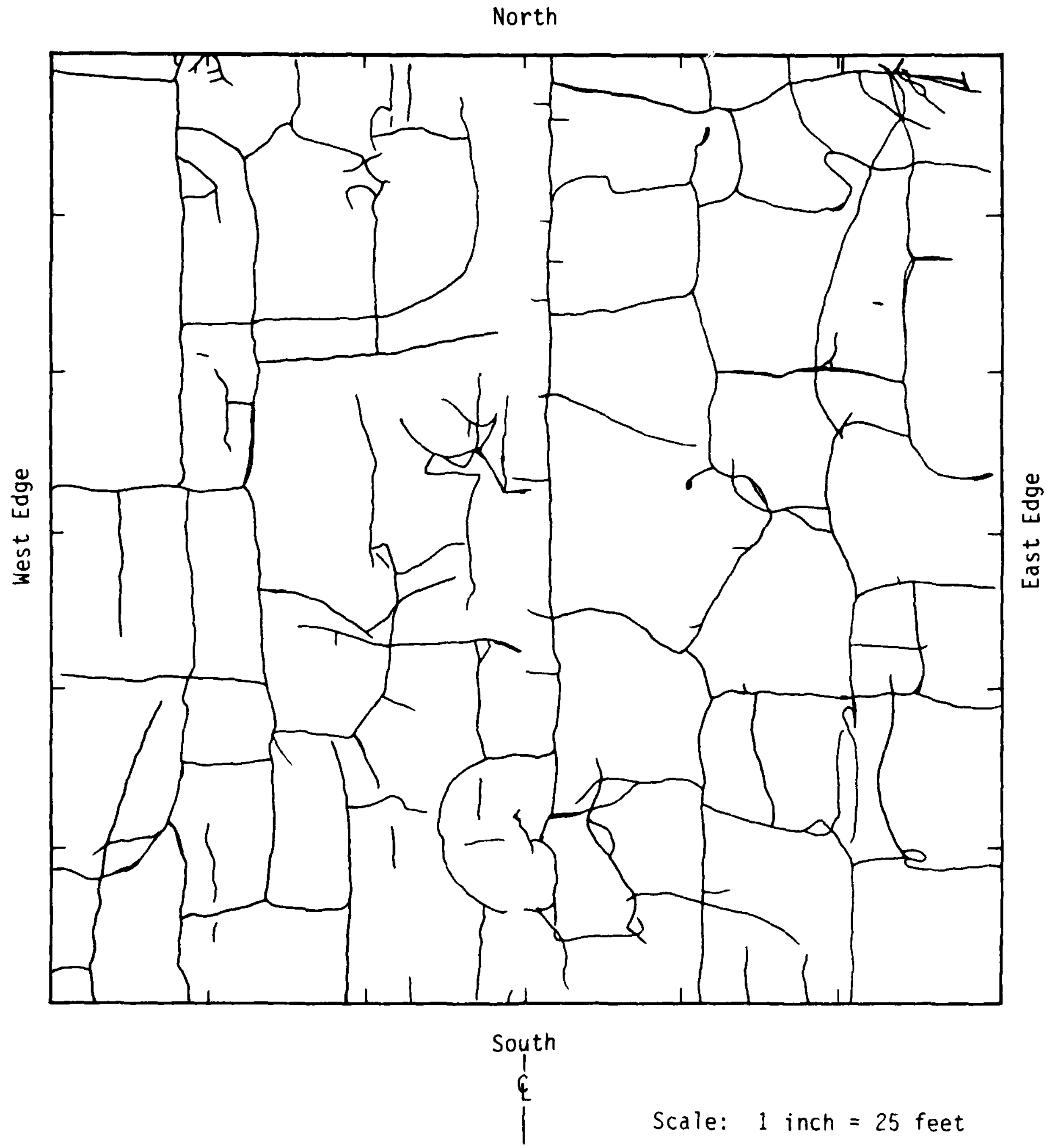


Figure 3. Existing Cracking at Williams AFB Before Overlay.

WILLIAMS AFB

Test section on Runway 12L/30R

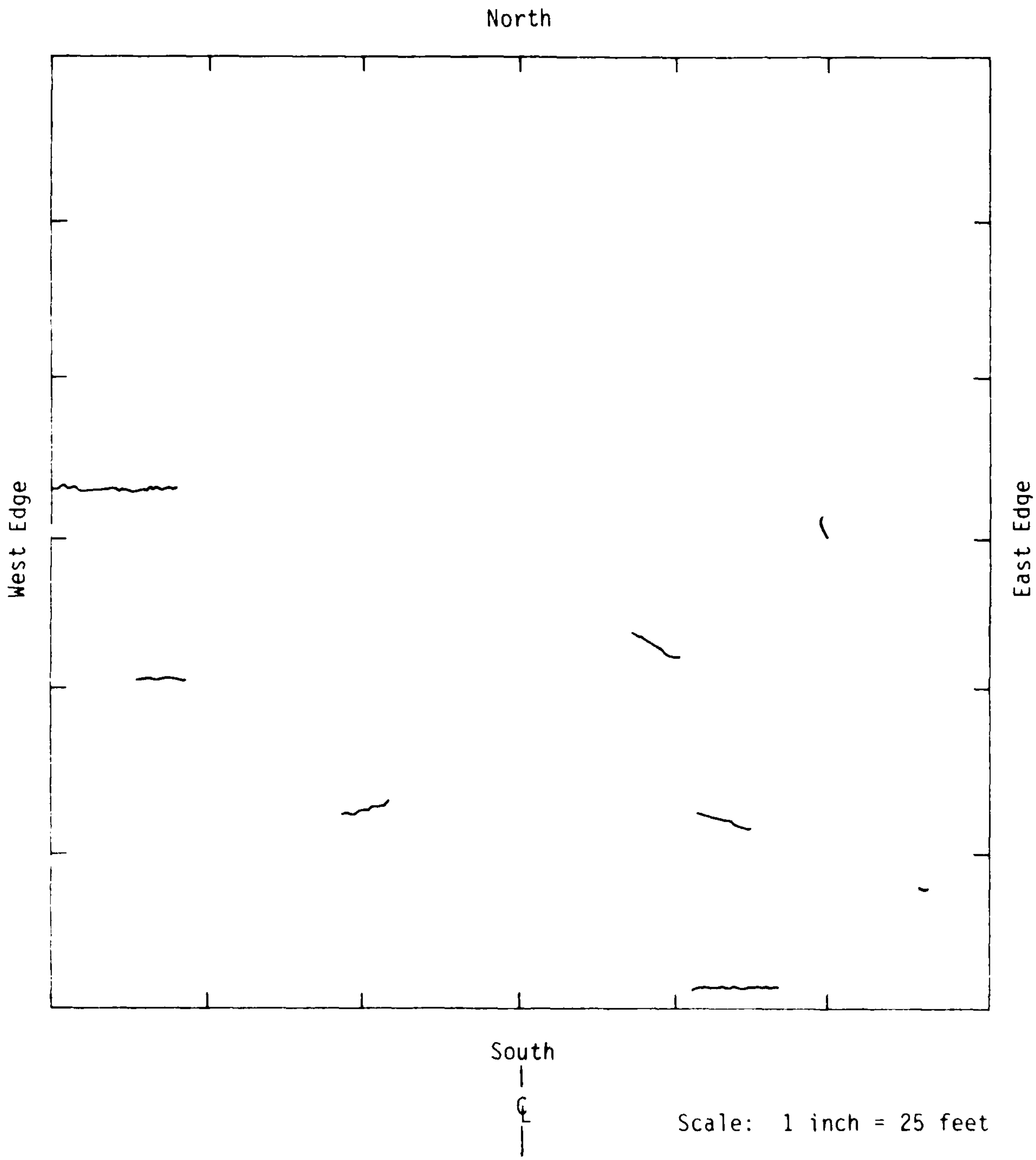
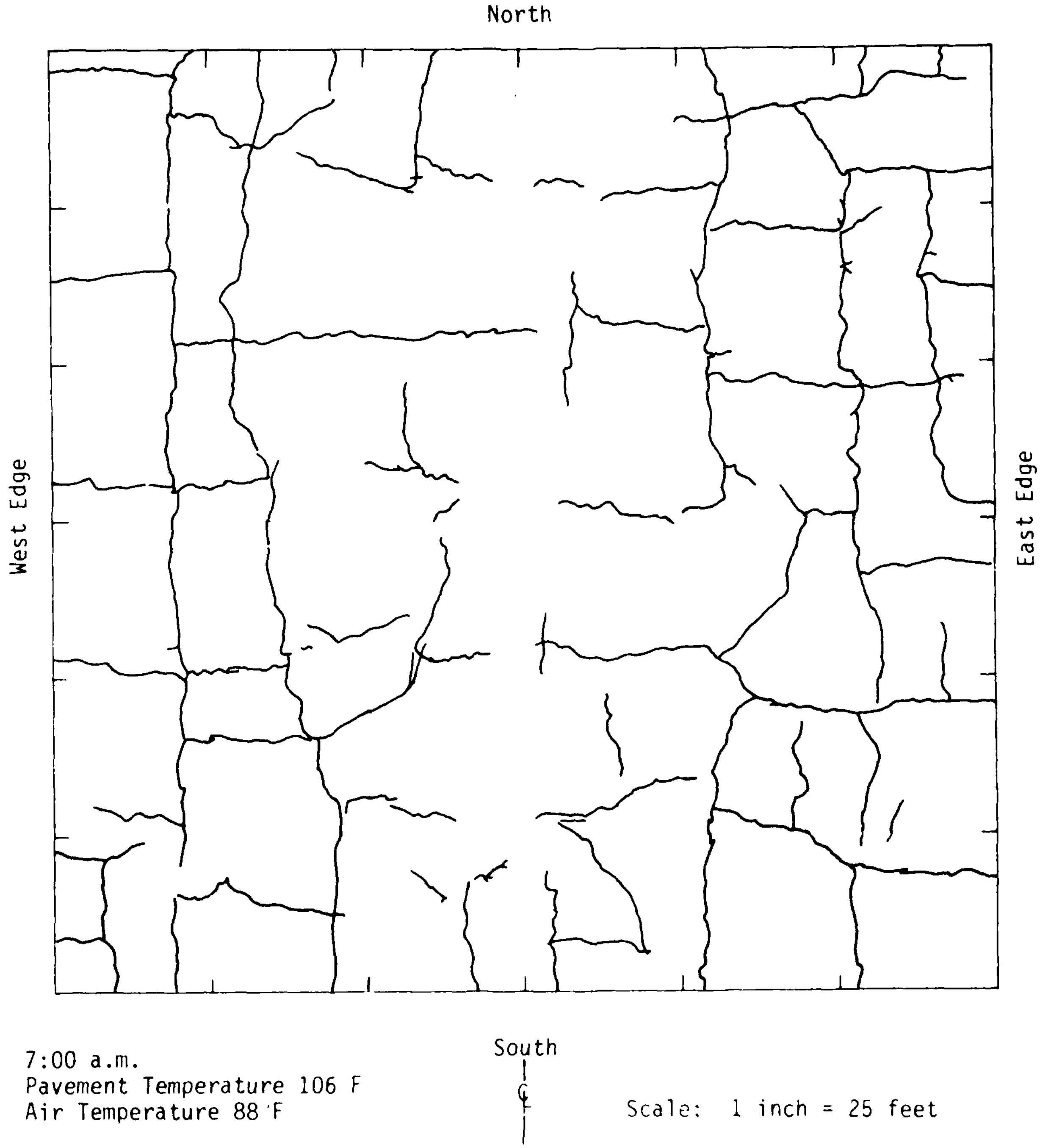


Figure 4. Existing Cracking at Williams AFB, November 3, 1984.

WILLIAMS AFB

Test section on Runway 12L/30R



7:00 a.m.
Pavement Temperature 106 F
Air Temperature 88 °F

Scale: 1 inch = 25 feet

Figure 5. Williams AFB, July 6, 1985.

COOLIDGE AIRPORT

Test section on Runway 5/23

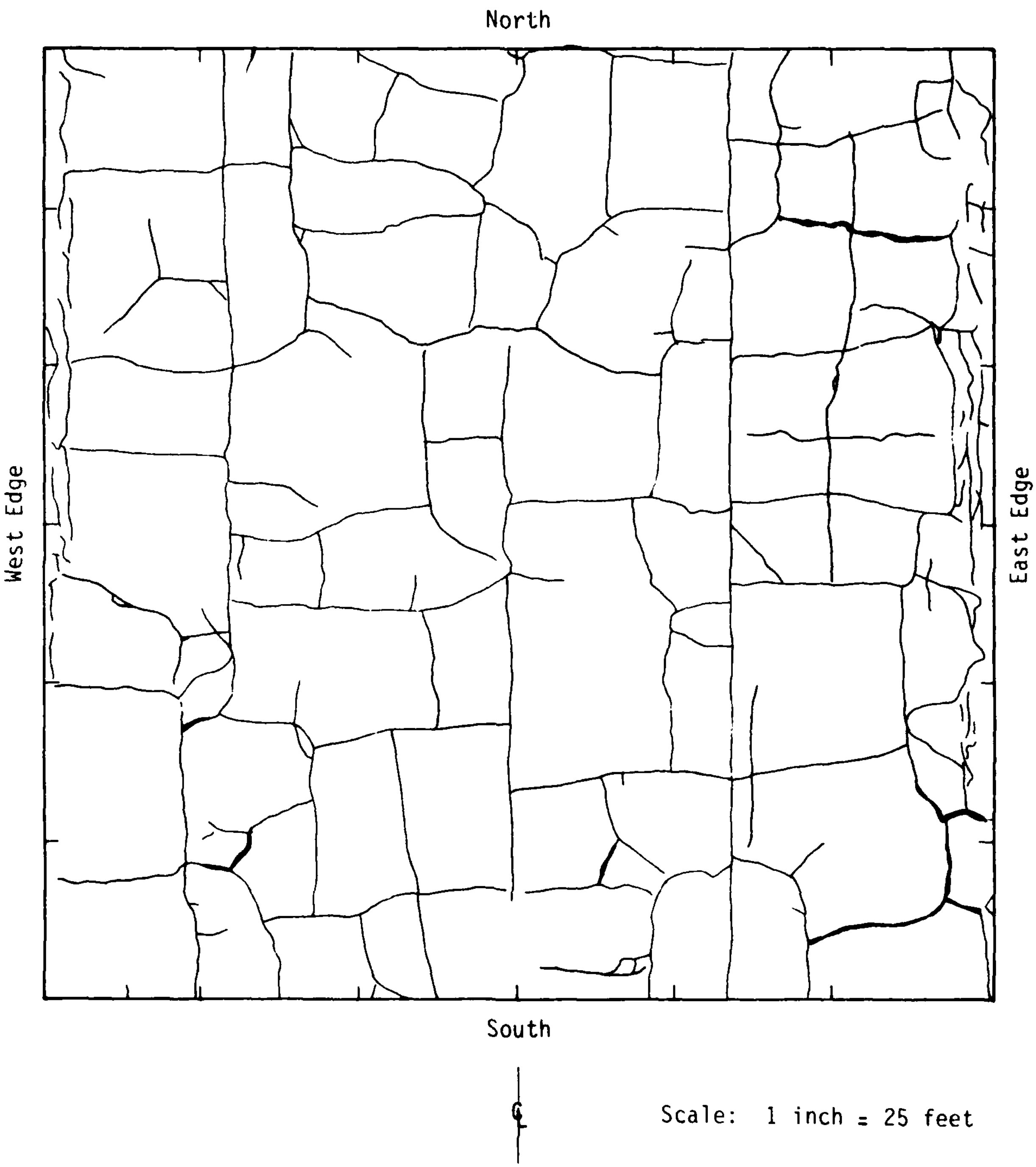


Figure 6. Existing Cracking at Coolidge Airport Before Overlay.

COOLIDGE AIRPORT

Test section on Runway 5/23

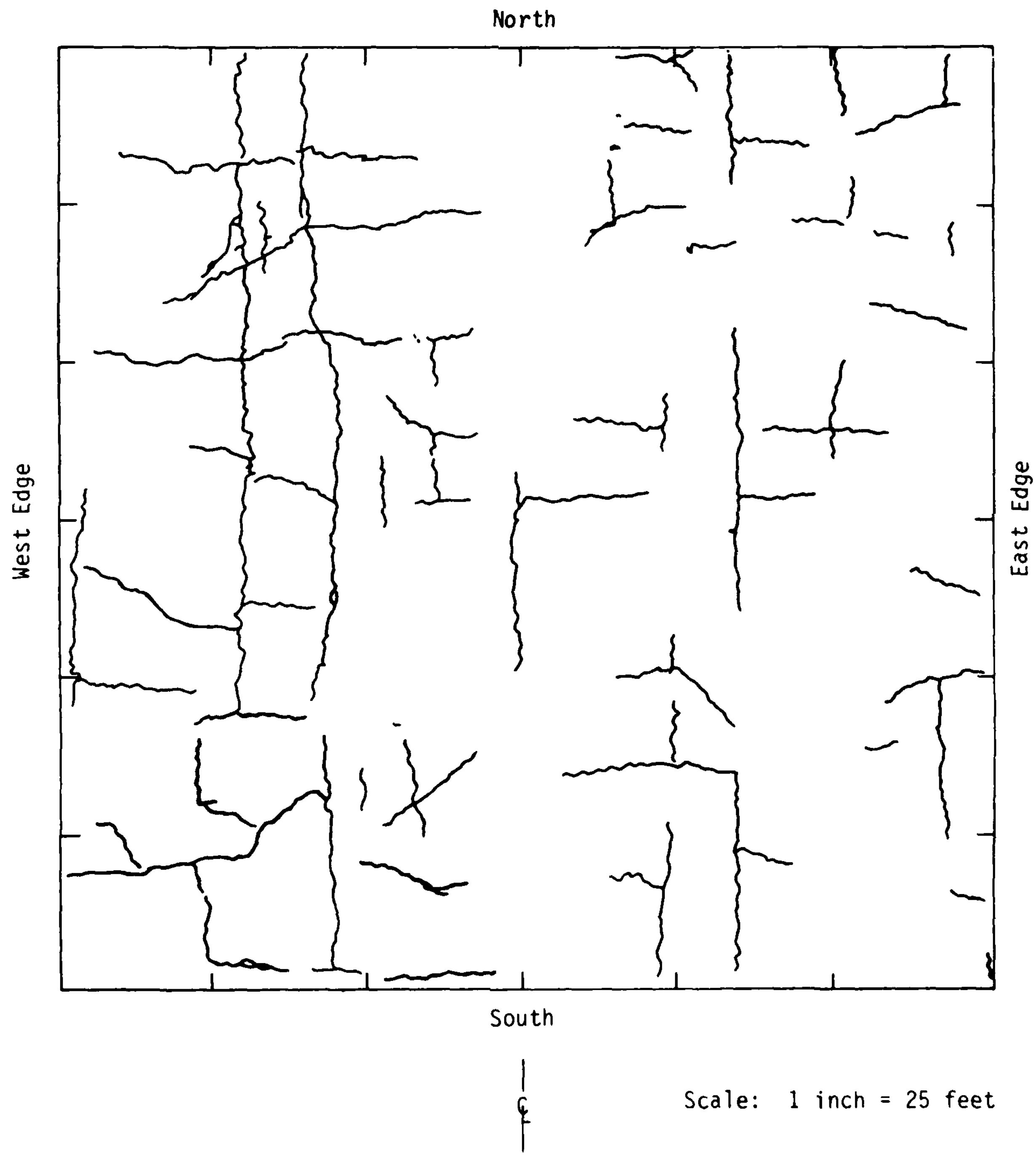
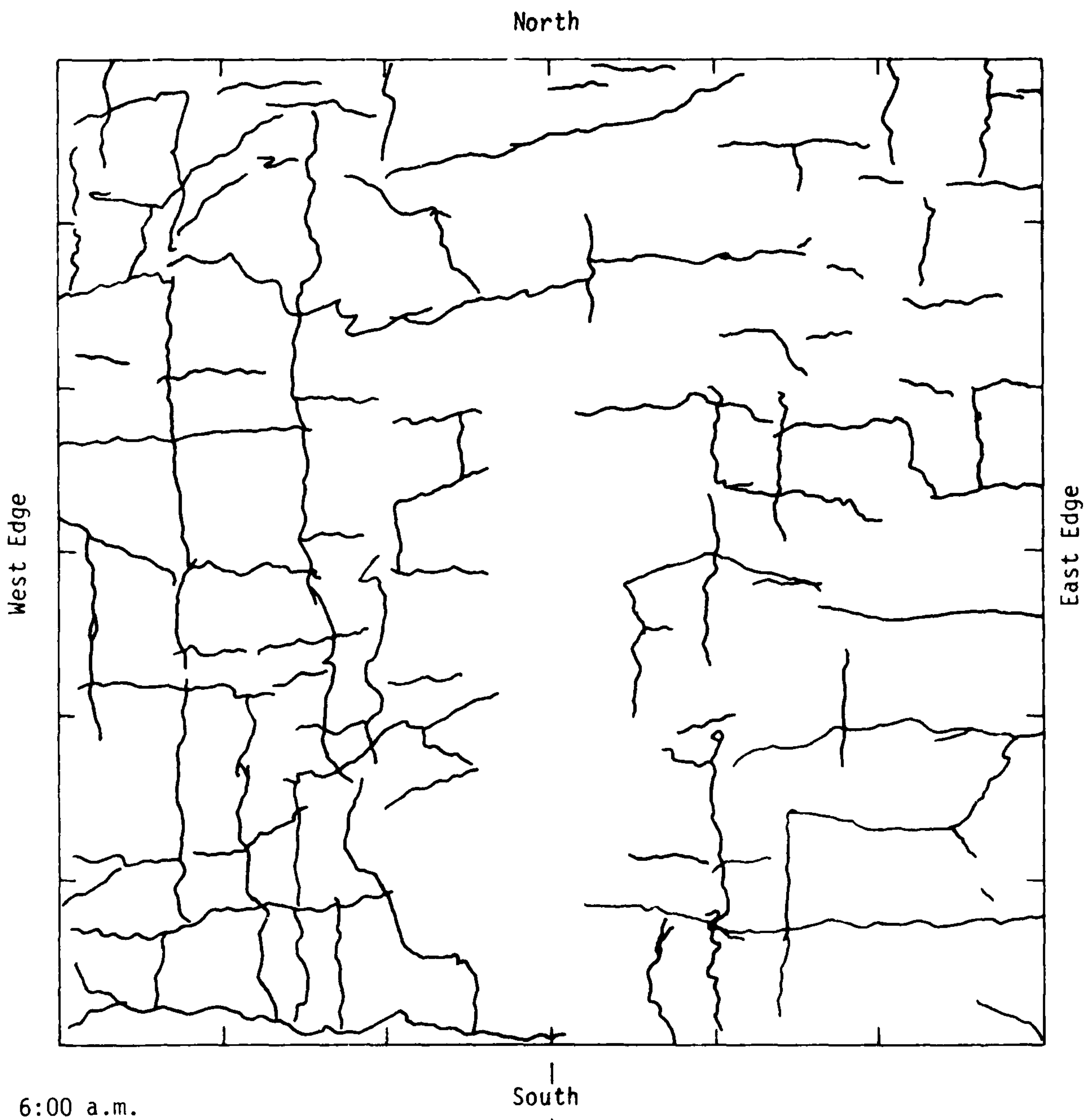


Figure 7. Existing Cracking at Coolidge Airport, November 2, 1984.

COOLIDGE AIRPORT

Test section on Runway 5/23



6:00 a.m.
Pavement Temperature 120° F
Air Temperature 102 F

℄

Scale: 1 inch = 25 feet

Figure 8. Coolidge Municipal Airport, July 5, 1985.

TABLE 9. RESULTS OF EVALUATIONS AT ARIZONA SITES

	AGE, yr	TOTAL CRACKING, m (ft)	RELATIVE CRACKING, m^{-1} (ft^{-1})	PERCENT OF ORIGINAL, %
Williams AFB				
Existing	---	712.3 (2337)	0.3409 (0.1039)	---
April 84	0.3	0 (0)	0 (0)	0
Nov 84	0.9	20.7 (68)	0.0098 (0.0030)	2.9
July 85	1.5	531.7 (174)	0.2539 (0.0774)	74.5
Coolidge Field				
Existing	---	762.3 (2501)	0.3647 0.1112	---
April 84	0.2	0 (0)	--- ---	0
Nov 84	0.8	394.7 (1295)	0.1888 (0.0576)	51.8
July 85	1.4	641.0 (2103)	0.3067 (0.0935)	84.1

SECTION V
PETERSON AFB FIELD TRIAL

A. OBJECTIVES

Objectives of this field trial were to evaluate performance of various materials used to reduce reflection cracks in asphalt-concrete overlays over portland cement concrete or soil cement bases. Both interlayers and a rubber-filled asphalt-concrete were included. Interlayers or SAMIs are thin layers of selected materials placed between the existing surface and the new overlay. Rubber-filled asphalt-concrete includes rubber in the mix that does not dissolve to the extent achieved in asphalt-rubber mixtures.

B. LOCATION

The study site was at Peterson AFB, Colorado, on an apron-improvement project under the jurisdiction of the Space Command. Trial sections were located in a strip 21.3 meters (70 feet) wide by 1417 meters (4650 feet) in length between the apron and taxiway 12-31. The study began at the northwest end of the complex and continued to the existing Air National Guard Hangers.

The study area consisted of two overall sections. The western section (station 0+00 to 33+00) was an asphalt or tar concrete over a 15 cm (6-inch) portland cement concrete pavement. The section from Station 33+00 to 46+50 consisted of asphalt or tar concrete over a 15 cm (6-inch) base of soil cement. Asphalt or tar concrete thicknesses varied from 4.4 cm to 15 cm (1.75 to 6 inches).

Crack patterns were quite different for the two overall sections. The portland cement concrete base section showed uniform block cracking that reflected the joint spacing of the underlying pavement. Sections over soil cement base showed considerable random and alligator cracking.

Table 10 lists materials used in the study. Specifications for these materials are included in Appendix D.

TABLE 10. EXPERIMENTAL MATERIALS

DESIGNATION	MATERIAL
A	Control (3 inches hot mixed asphalt concrete)
B	Asphalt-rubber membrane with asphalt-concrete overlay
C	Polymer modified asphalt-rubber membrane with asphalt-concrete overlay
D	Rubber-filled asphalt-concrete
E	Polypropylene fabric membrane with asphalt-concrete overlay
F	Asphalt-concrete with saw cuts at the pattern of underlying cracks (Note: This trial section used only on the area with portland cement concrete base.)

C. DESIGN OF THE EXPERIMENT

The study consisted of a completely randomized layout in both the portland cement concrete and soil cement base sections with two replications for each base area. The soil cement area did not contain sections using sawed asphalt-concrete.

1. Subsection layout

The entire trial section consisted of 22 subsections: 12 subsections 84 by 21.3 meters (275 by 70 feet) included in the major section with a portland cement concrete base, and 10 subsections of 41.1 by 21.3 meters (135 by 70 feet) included in the major section with the soil cement base.

Trial sections were randomized within each major subsection (see Figure C-1 in Appendix C). Note that sawed asphalt-concrete is not included in the major section with soil cement base.

2. Analysis

Analysis was by conventional analysis of variance (ANOVA). See Appendix C for factorial layout and ANOVA. Note that two separate analyses were required to accommodate the requirement of not including sawed subsections in the soil cement area. One analysis is a one-way ANOVA whereas the other is a two-way ANOVA. Note that the factorial for analysis may require modification to include crack patterns or sealant deficiencies that develop in the sawed subsections. At this writing, it is suggested that cracks that develop within the sealant or separation within the sealant or between sealant and substrate may be considered as open cracks during crack and performance surveys.

Provisions have been made available on the field data sheets [7.6-meter (25-foot) divisions within each subdivision] to consider transitions at each end of a particular treatment (subsection) and to eliminate these, if necessary, with appropriate "t" tests or by use of ASTM E 178 test for outlying observations.

3. Dependent (response) variable

Cracking was measured by lineal meters of cracking (lineal feet of cracking) and by relative cracking or lineal meters of cracking per square meter of pavement (lineal feet of cracking per square foot of pavement).

The analysis was based on cracking that has reflected through the treatment which was recorded as percent of original cracking.

D. SEQUENCE OF EVENTS FOR PAVING OPERATIONS

Milling of the study area took place between September 6 and September 18, 1985. Depth of the milling varied from 19 to 76 mm (0.75 to 3 inches). Asphalt wedges were placed at the edges of the milled area to allow traffic to cross from the taxiway to the parking apron. These wedges consisted of an asphalt-concrete mat beveled from the high edge of the cut to the surface of the milled section. Before all hot-mix placements, these wedges were removed from the designated areas to be paved. A tack coat, consisting of a 50-50 solution of SS-1 emulsified asphalt, was distributed at a rate of 0.08 gal/yd^2 on all the sections to be overlaid. Appendix F, Table F-1, gives the schedule for all the paving operations for the apron-taxiway improvement project at Peterson AFB.

Paving operations began on September 25 between Stations 13 + 75 and 22 + 00, which included large sections F, F, and E. Petromat was placed after an AC-10 had been shot onto the Section E area. Laydown began at Station 13 + 75, next to the adjoining taxiway. A Blaw-Knox, PF-180 model paver was used for the laydown of the hot mix. Rain showers shut down the operation after two-thirds of the first lane had been placed. On the first day, 135 tons were placed, with the last 30 tons being placed in the rain.

Crafco International began placing the asphalt-rubber and polymer-modified asphalt-rubber interlayers also on September 25. Small sections C, B, and C, between Stations 38 + 40 and 45 + 15, were covered with the interlayers.

No hot-mix paving was done on September 26 because of the rain showers of the 25th, which had wet the Petromat. Crafco completed placing the rubber interlayers on the 26th. The asphalt-rubber and modified asphalt-rubber were applied at a rate of 0.67 gal/yd^2. Chips with a maximum size of 1.3 cm (0.5 inch) were distributed after the hot asphalt-rubber laydown at a rate of 36 lb/yd^2.

Hot-mix paving began again on September 27 at the cold joint, Station 20 + 05, where the lane on September 25 ended. Two lanes, 6 meters (20 feet) wide were placed, and then the width was increased to 3.8 meters (12.5 feet) for the next four lanes. The junction of the 6-meter width with that of the 15-meter (50-foot) width is the low point of the area. This low point is the swale in the pavement for drainage with the flow being from west to east.

Compaction of the hot asphalt-concrete consisted of breakdown rolling with a dynamic D-50 Ingersoll-Rand dual tandem steel wheel roller operating at 1600 vibrations a minute with a dynamic weight of 21,000 pound. A 10-ton, C-530 Hyster rubber tire roller, inflation pressure 70 psi, was used for further compaction. Finish rolling with a 12-ton dual-tandem Hyster 03500 steel wheel roller completed the surface rolling.

No further paving was done until October 5 because of inclement weather and the breakdown of the asphalt batch plant. Small sections E, C, B, A, E, and C were overlaid on October 5. On October 7, small sections A and B and large sections E, A, B, A, and C were paved. The rubber-filled asphalt-concrete,

sections D and S, were paved on October 12 due to the change in batch plant setup necessary to incorporate the rubber aggregate. The data for the laboratory and field tests on the rubber-filled asphalt-concrete are presented in Table F-4, Appendix F.

1. Laboratory testing

Samples of the hot asphalt-concrete overlay were taken from trucks at the batch plant for testing. Marshall test specimens were prepared for unit weight, stability, flow, and asphalt content. The results from these tests are given in Appendix F, Table F-2. The trucks from which the samples were taken were identified, and field core samples were taken from the pavement mat where these batches were placed for unit weight data comparison. Asphalt from the Marshall core sample was extracted and sieve analysis tests were run on the aggregate for gradation. The gradation results and the specifications for the aggregate design mix are given in Appendix F, Table F-3.

2. Field testing

Asphalt-concrete core samples were taken in the field for unit weight compaction specification conformance. Four cores were taken for each lot, two in the lane and two in the joints between lanes. The density from compaction rolling was also taken with a nuclear density meter for correlation with the core samples. After correlation, the nuclear meter can indicate the percent of density obtained as compared to the laboratory Marshall samples. Appendix F, Table F-2 gives the location and data obtained from the core samples.

SECTION VI
CONCLUSIONS AND RECOMMENDATIONS

A. APRON A, KIRTLAND AFB

Observations of cracking were reported through 3.6 years following construction. When these data are analyzed using standard statistical methods, no significant differences are found, except in the case of Control Section I. At ages 2.2, 2.6, and 3.6 years, Control Section I exhibits significantly more cracking. This cracking is believed to be the result of fuel-truck traffic using Control Section I. The remaining portions of the apron were not subjected to this traffic. It is concluded after 3.6 years of service that no significant difference is observed when the various SAMI treatments are compared to Control Section II.

Performance data in the future should be obtained to document long-term benefits of the SAMI. Although cracks have appeared in the overlay the condition of the apron is still good and the cracking is much less than the old pavement exhibited.

One observation, made at 1.5 years of age, revealed that the long mix time (160 minutes) exhibited more cracking than all other asphalt rubber test sections and Control Section II. At other ages, these differences were not significant. This observation does seem to confirm the limitation on mix time generally used in the industry.

Figure 9 illustrates the growth of the overall average cracking index with age. The drop in cracking index at 3.6 years is real. It is believed to be the result of hot weather (survey was performed in July) combined with an increased traffic level. The commercial traffic began using the south end in the spring of 1985 and KAFB operations moved about the same time, routing much of the transient military aircraft over Apron A. Future observations should supplement this conclusion.

The SAMI has not shown a measurable effect on the development of reflection cracking in the overlay. It remains to be determined how the SAMI will influence performance of the overlay following development of reflection

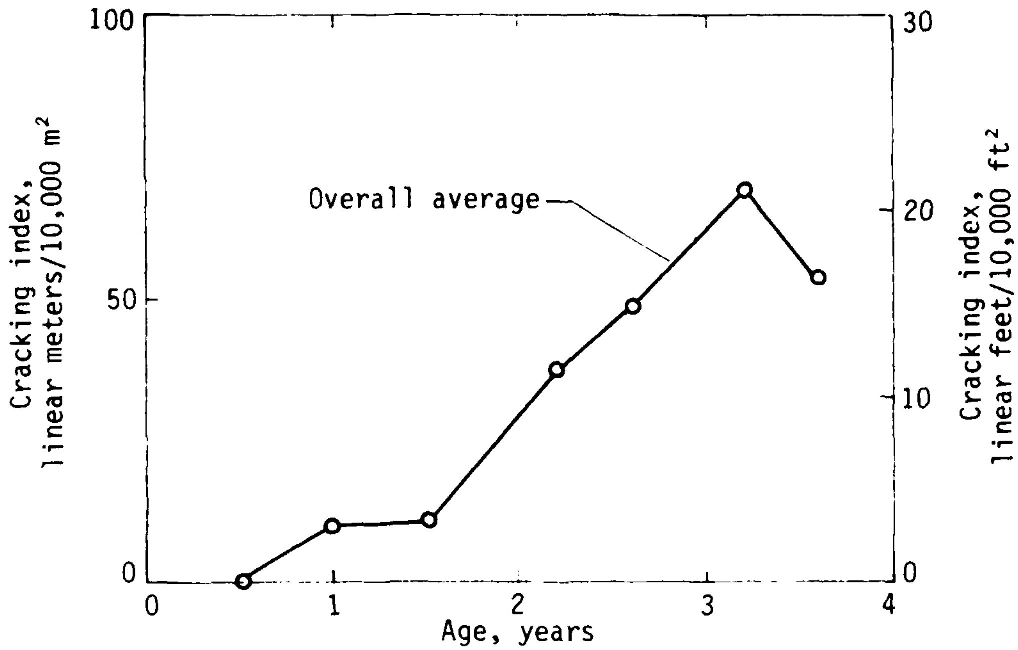


Figure 9. Cracking Index Data for Apron A.

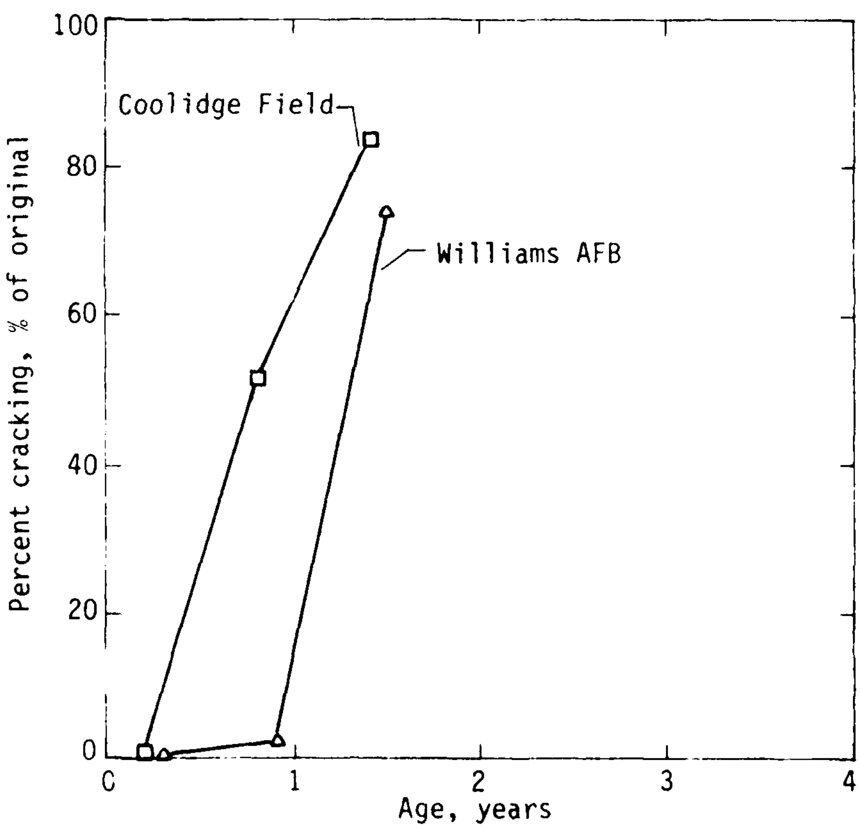


Figure 10. Percent Cracking Data for Arizona Sites.

cracking. The ability of the material to seal cracks after they develop should prevent water entrance and subsequent deterioration of the subgrade. Continued monitoring of the apron condition is required to determine whether the SAMI will outperform the control section at greater ages.

B. WILLIAMS AFB/COOLIDGE FIELD

No control sections were built for these sites. The intended purpose was to observe the rate at which cracks reappeared and monitor the long-term performance. Figure 10 shows data through about 1 year in terms of percent cracking. The percent is computed based on the original amount of cracking before overlay. The Williams AFB results show about a 6-month delay in the cracking compared to Coolidge Field. Four factors may have influenced this behavior: (1) the pavements are located at two different sites, with different traffic and weather; (2) Williams AFB has a thicker pavement; (3) about two-thirds of the Williams AFB test section was milled prior to overlay; and (4) the crack sealing at Coolidge Field resulted in excessive amounts of emulsion at the cracks and sand on the pavement surface.

Once the cracks are reflected through it is important to make observations of behavior to determine what the long-term overlay performance will be.

C. PETERSON AFB

The Peterson AFB test section is an excellent opportunity to obtain field comparison data on the performance of several methods of retarding reflection cracking. The experiment was statistically designed and included repetition of the treatments. Since it was only recently completed no observations are available at this time.

D. SPECIFICATIONS

A proposed specification for asphalt-rubber materials to be used in SAMI construction was previously reported (Reference 2). A revised specification was used in the Peterson AFB construction and is enclosed as Appendix D, Section D-2. This specification covers both procedures for preparation of the material.

E. RECOMMENDATIONS

Experiments discussed in this report are continuing. The documentation of performance as they continue to age is vital to successful completion of the experiment and full realization of the initial investment in the experiment construction. Continued funding to cover the monitoring costs should be given a high priority.

The asphalt-rubber specification contained in the appendix should be adopted for further evaluation in real construction projects.

REFERENCES

1. Decker, D. S., Griffin, D. F., and Nielsen, J. P., **An Evaluation of Asphalt-Rubber Mixtures for Use in Pavement Systems**, CEEDO-TR-79-02, Air Force Engineering and Services Center, Tyndall Air Force Base, Florida, January 1979.

2. Newcomb, D. E., and McKeen, R. G., **Development of Criteria for the Use of Asphalt-Rubber as a Stress-Absorbing Membrane Interlayer (SAMI)**, ESL-TR-83-50, Air Force Engineering and Services Center, Tyndall Air Force Base, Florida, December 1983.

3. McKeen, R. Gordon, **Asphalt-Rubber SAMI Test Sections**, NMERI TA5-17, Letter Report, Air Force Engineering and Services Center, Tyndall Air Force Base, Florida, September 1984.

4. Shuler, T. S., Pavlovich, R. D., and Epps, J. A., "Field Performance of Rubber Modified Asphalt Paving Materials," paper presented at the Annual Meeting of the Transportation Research Board, January 1985.

5. **Annual Book of ASTM Standards**, Section 5, "Petroleum Products, Lubricants and Fossil Fuels," D217-82, 1985, pp. 142-153.

(The reverse of this page is blank.)

APPENDIX A
DD FORM 1391C FOR ARIZONA PROJECTS

1983 MILITARY CONSTRUCTI[illegible] PROJECT DATA

AIR FORCE

3. INSTALLATION AND LOCATION

WILLIAMS AIR FORCE BASE, ARIZONA

4. PROJECT TITLE

MAINTAIN RUNWAY 12L/30R

5. PROJECT NUMBER

WI 83-1365 (521)

PAVEMENT PROJECT QUESTIONNAIRE

INSTALLATION:	Williams AFB Az	FACILITY:	Runway 12L-30R
MAJCOM:	ATC	FEATURE:	R2C
O&M PROJ NO:	WI 83-1365	DATE PREPARED:	22 April 1983
CAT CODE:	111-111	REPLACEMENT COST:	$2,?85,000

I. FAMILIARIZATION & HISTORY

A. Pavement Description

1. Subject runway was constructed in 1970
2. Pavement type is flexible
3. Cross section of runway.

   4 inches asphaltic concrete surface
   6 inch base course: GW-GM
     P.I: N.P.
     CBR: 60
     Density: 99% CE 55
   8 inch subbase: SM
     PI: N.P.
     CBR: 22
     Density 97% CE 55
   Subgrade: CL-ML
     PI: 6
     CBR: 10
     Density: 86% CE 55

4. Paved area is 121,667 S.Y.
5. Design loading: Light

B. Traffic [illegible] (passes per year):

1. [illegible] F-5, 5100
   T-38, [illegible],300

2. [illegible] F-5, [illegible]00
   T-38, [illegible]7,000

3. [illegible]

4. [illegible] ory

AIR FORCE	1983 MILITARY CONSTRUCTION PROJECT DATA	28 Apr 83

3. INSTALLATION AND LOCATION

WILLIAMS AIR FORCE BASE, ARIZONA

4. PROJECT TITLE	5. PROJECT NUMBER
MAINTAIN RUNWAY 12L/30R	WI 83-1365 (521)

5. Gross takeoff weight for mission aircraft:

AIRCRAFT	MAXIMUM (LB)	NORMAL (LB)
T-38	12,000	12,000

C. Condition of paved area

1. PCI: 65
Overall condition: Good

2. Variation of condition

a. Localized random variation: Yes

b. Systematic variation: No

3. Rate of deterioration of condition

a. Long term: Normal

b. Short term: High

4. Load-carrying evaluation

a. Date of evaluation: June 1977

b. Allowable gross load, last evaluation:
(1) Light load: 60,000 (capacity category)
(2) Medium load: 325,000
(3) Heavy load: 320,000

5. Surface roughness: Moderate, no evaluation

6. Skid resistance /Hydroplaning (15 minute test):

a. Mu-meter: Date, May 1982, Hydroplaning not probable (MU=0.71)

b. Stopping distance ratio: Date, May 1982, Hydroplaning not probable (SDR=1.24-1.40)

c. Transverse slope
Fair (1.0-1.3%)

7. Primary reason for deterioration: Deterioration of two types has occurred:

DD FORM 1391c PREVIOUS EDITION IS OBSOLETE IN THE USAF. PAGE NO

U.S. G.P.O. 1977-241-130/1215

1. COMPONENT AIR FORCE	FY 19 83 MILITARY CONSTRUCTION PROJECT DATA	2. DATE 26 Apr 83
3. INSTALLATION AND LOCATION WILLIAMS AIR FORCE BASE, ARIZONA		
4. PROJECT TITLE MAINTAIN RUNWAY 12L/30R		5. PROJECT NUMBER WI 83-1365 (521)

a. Longitudinal and transverse cracking developed at a moderate rate in past years but has accelerated in the last two years. Some areas are now rated as block cracking. A concentrated effort has been recently made to seal all the cracks. During a pavement condition survey made 8 Apr 1983, approximately 95% of the cracks were rated low severity due to the satisfactory condition of the crack sealing. It is estimated that the PCI of 65 for this pavement would have been 55 before these cracks were sealed. According to the PCI survey, 113,000 L.F. of cracks exist in this feature. Due to the advanced age of the pavement and the hot day climate of this area, the rate of cracking is expected to increase, resulting in unacceptable FOD and maintenance problems.

b. Weathering or loss of binder and fines has occurred at a low severity level in approximately 50% of the area. In general the larger aggregate is still well bonded, however pieces of 3/4 inch quartz aggregate are popping loose over the entire area. Although the percentage of this type aggregate in the total mix is very low the effect over the large area is very significant, causing a serious FOD potential to tires and engines. This condition is also accellerating with the advanced age of the pavement. The distresses are all climate/durability associated. Moisture accellerated distress is minor.

D. Condition of:

1. Drainage system consists of open ditches, 250 feet from the runway edges. Condition is very good.

2. Underground utilities. None exist in the area. The runway is not lighted.

E. Previous Maintenance: High

F. Maintenance projects on pavements included in project for last five years.

1. O&M Projects

Project No.	FY	Type Work	Total Cost
81-1360	81	Resurface (5,000 s.y.)	$28,750
81-1347	81	Repr Junctures at p.c.c joints	$17,000
79-0932	80	Fog Seal & Herbicide	$19,130

2. In-House Projects; no separate project. Estimated cost of crack sealing done during FY 82 and 83 is $36,000.

DD FORM 1 DEC 76 1391c

1. COMPONENT		2. DATE
AIR FORCE	FY 1983 MILITARY CONSTRUCTION PROJECT DATA	26 Apr 83
3. INSTALLATION AND LOCATION		
WILLIAMS AIR FORCE BASE, ARIZONA		
4. PROJECT TITLE		5. PROJECT NUMBER
MAINTAIN RUNWAY 12L/30R		WI 83-1365 (521)

II Proposed Project:

A. Location of work: Includes all of the flexible pavement portion of Runway 12L-30R (150'x7300').

B. What will be done to solve the problem?

1. Apply a stress absorbing membrane interlayer (SAMI) and 1 1/2 inch hot plant mixed asphaltic concrete overlay. The SAMI consists of 0.5 gallons per square yard of a hot asphalt cement - rubber mixture with an aggregate cover.

2. Type and characteristics of soil (Based on two pits)
   a. Classification: CL-ML
   b. Density: 93%-79% (CE55)
   c. Moisture content: 12.4%-20.6%
      Wp/Ip: 21/5-24/8

3. Electrical work: none involved

4. Additional pavement resulting from project: None

5. Blast fences not required.

6. How will this work precludes early recurrence of the problem? Use of the SAMI will greatly reduce reflective cracking through the overlay.

7. Why was this method chosen? Resurfacing is necessary to provide a suitable surface and reduces maintenance and FOD. Recycling is not desirable due to the unsuitable aggreagte in the existing surface mixture.

C. This is not an alert, maintenance, refueling or full time parking area.

D. If the requested work is not preformed, the area in question would be deteriorated to the extent that condemnation would be necessitated in approximately six to eight years.

DD FORM 1391c PREVIOUS EDITION IS OBSOLETE IN THE USAF PAGE NO

1. COMPONENT AIR FORCE	FY 19__ MILITARY CONSTRUCTION PROJECT DATA	2. DATE 13 Apr 83

3. INSTALLATION AND LOCATION
WILLIAMS AIR FORCE BASE, ARIZONA

4. PROJECT TITLE OVERLAY COOLIDGE RUNWAY	5. PROJECT NUMBER WI 83-1580

PAVEMENT PROJECT QUESTIONNAIRE

INSTALLATION: Williams Air Force Base, Arizona
MAJCOM: ATC
CATEGORY CODE: 111-111
FACILITY: Coolidge-Florence MAP
FEATURE: R/W 5-23
DATE: 13 April 1983
REPLACEMENT COST: $2,415,000

I. Familiarization and History.

A. Pavement Description:

1. When was pavement constructed? 1942; overlaid 1962.

2. Type of pavement: Flexible.

3. Cross section of pavement.
1 1/2 in HMAC overlay.
2 in AC-Field mix.
6 in base course - CBR 50.
3 in sub-base - CBR 30.
Subgrade - CBR 25.

4. How large is paved area? 105,600 SY.

5. Design loading characteristic: Light load.

B. Traffic Concentration.

1 & 2. Air Force traffic at this airport consists of touch-and-go and low approach training in T-37 aircraft. Only one full stop landing and takeoff is made each day. Other traffic at the airport consists mainly of light privately owned aircraft. The only traffic with significant loading is by C-46 aircraft used for sky diving and converted B-17, B-24, C-119, and PV-2 aircraft used for slurry bombing during the fire season. The number of operations by these aircraft is not available.

3. No change in mission aircraft use is anticipated. Future use by private aircraft is not anticipated to change.

4. Pavement system is primary.

5. Gross takeoff weight for mission aircraft:

Aircraft	Maximum (lb)	Normal (lb)
T-37	7200	6500

C. Condition of paved area in question.

1. PCI: 47
Condition Rating: Fair

2. Variation of condition within feature
a. Localized random variation: Yes
b. Systematic variation: No

DD FORM 1 DEC 76 1391c PREVIOUS EDITION IS OBSOLETE IN THE USAF. PAGE NO

1. COMPONENT	FY 19__ MILITARY CONSTRUCTION PROJECT DATA	2. DATE
3. INSTALLATION AND LOCATION		
4. PROJECT TITLE		5. PROJECT NUMBER

3. Rate of deterioration of condition
   a. Long term period - Normal
   b. Short term period - High
4. Load carrying evaluation
   a. Date of evaluation: 1944
   b. Allowable gross load last evaluation: (The cross section information shown in paragraph A3 above was taken from an evaluation made by US Army Corps of Engineers in 1944. No further information is available from that evaluation).
5. Surface Roughness
   Moderate (estimated)
   No evaluation
6. Skid resistance
   a & b. No evaluation. Estimate hydroplaning is possible.
   c. Transverse slope: Fair
7. Primary reason for deterioration. Deterioration began soon after the overlay was placed in 1962, due to reflection of cracks in underlying pavement. Rate of deterioration has been moderate until early 1983 when rate became rapid.
   a. Distress evaluation
      1. Load associated distress, 25% (50% locally)
      2. Climate/durability, 75%.
   b. Moisture accelerated distress. Minor except in local areas where landing aircraft making 180° turns to return to the parking apron have caused failure of the base and subbase. These materials were saturated due to unusual rainfall during the winter of 1982-83.

D. Condition
   1. Drainage system. Adequate. Shoulders are well graded to drain ditches. Underground piping connecting to these ditches are satisfactory.
   2. Utilities: Runway lighting was installed by the City of Coolidge in 1980. Lights are located 10 feet from runway edges and are in satisfactory condition.

E. Previous Maintenance: High.

DD FORM 1 DEC 76 1391c PREVIOUS EDITION IS OBSOLETE IN THE USAF. PAGE NO

1. COMPONENT	FY 19__ MILITARY CONSTRUCTION PROJECT DATA	2. DATE
3. INSTALLATION AND LOCATION		
4. PROJECT TITLE		5. PROJECT NUMBER

F. Maintenance projects on pavements included in project for last five years.

O&M PROJECTS

Project No	FY	Type Work	Total Cost
WI 83-1570	83	Replace 460 SY of pavement and subgrade	14,500
WI 79-0933	81	Seal cracks, apply herbicide, fog seal	58,585
WI 77-0702	77	Seal cracks, apply herbicide, fog seal	38,300

IN-HOUSE PROJECTS

No separate projects, continual maintenance work including sweeping, grading of shoulders and crack sealing.

II. Proposed Project:

A. Location of Work: All of runway 05-23 and a 50' x 2230' taxiway connecting to the parking apron.

B. What will be done to solve the problem?

1. Type and thickness of proposed construction: Apply a stress absorbing membrane interlayer (SAMI) and 1 1/2 inch hot plant-mixed asphaltic concrete overlay. SAMI consists of 0.5 to 0.6 gallons per square yards of hot asphalt-rubber mixture covered with a light chip coat.

2. Type and characteristics of soil. No soil tests are available. Soil appears to be MC and CL with some SC. Available information shown in paragraph I.A.3.

3. Electrical work: None involved. Protect runway edge lights and threshold bars.

4. Additional pavement resulting from project: None

5. Blast fences not required.

6. How will project prevent early recurrence of the problem? The SAMI application will greatly reduce or eliminate reflective cracking, thus preventing infiltration of surface moisture and reducing FOD resulting from cracking.

7. Why was this method chosen? The history of this pavement has demonstrated that the base and subgrade are adequate for the type of aircraft using the field, providing that they are protected from moisture, therefore no base or subgrade strengthening is considered necessary. Sealing of the cracks has been done repeatedly, both by contract and in-house forces; however, block cracking has progressed to

DD FORM 1 DEC 76 1391c PREVIOUS EDITION IS OBSOLETE IN THE USAF. PAGE NO

1. COMPONENT	FY 19__ MILITARY CONSTRUCTION PROJECT DATA	2. DATE
3. INSTALLATION AND LOCATION		
4. PROJECT TITLE		5. PROJECT NUMBER

such a state that crack sealing is no longer feasible. Recycling of the existing asphalt concrete surface would involve exposing the underlying base and subgrade to the operation of heavy constructon equipment. Past experience has shown this to cause complete loss of stabilization in these courses, requiring removal and reconstruction to the depth of several feet.

C. This is not an alert, maintenance, refueling or full time parking area.

D. If requested work is not performed the pavements would deteriorate to the point that they would be unsuitable for jet aircraft traffic within one year. A small area (460 SY) deteriorated to the extent that jet aircraft training could not continue during February 1983. This area has been repaired; however, surrounding areas are showing distress and could fail during next winters wet season.

DD FORM 1 DEC 76 1391c PREVIOUS EDITION IS OBSOLETE IN THE USAF PAGE NO

(The reverse of this page is blank.)

APPENDIX B

SPECIFICATIONS FOR ARIZONA PROJECTS

SECTION 02501

PAVEMENT PREPARATION

1. DESCRIPTION

1.1 WORK INCLUDED

1.1.1 Place "x" at runway ends. Barricade open excavation.

1.1.2 Patch by removing and replacing areas shown.

1.1.3 Leveling course at depressed areas.

1.1.4 Removing paint buildup.

1.1.5 Clean and sweep.

1.2 RELATED WORK SHOWN ELSEWHERE

1.2.1 Vegetation Control, Section 02252.

2. QUALITY ASSURANCE

2.1 American Society for Testing and Materials (ASTM):

DD 977-80 Emulsified Asphalts

2.2 Maricopa Association of Governments (MAG) Uniform Standard Specifications for Public Works Construction, 1979.

3. SUBMITTALS

3.1 Certification: Tack coat, aggregate base course.

4. MATERIALS

4.1 Aggregate Base Course (ABC): Conform to MAG Section 702.

4.2 Select Material: MAG Section 702, Type A.

4.3 Tack Coat: ASTM D-977, Type RS-1.

5. PREPARATION. Place "x" markings before working on runway. Barricade open excavations with lighted barriers as shown.

6. PATCHING

6.1 Cut pavement by approved method and remove all materialt to depth of 30 inches. Dispose on base where indicated and spread as directed. Do not use equipment on exposed subgrade until first layer of select backfill is placed.

6.2 Replace with 22 inches of select material, placed and compacted in two equal layers, and 6 inches of new ABC material compacted to 100% density. Except as otherwise noted, work will conform to MAG Section 310. Leveling course to conform to applicable portions of Section 02513, Bituminous Surface Course.

7. LEVELING COURSE: Low or depressed areas shown on the drawings and elsewhere as required shall be tack coated and leveled with the asphaltic concrete mixture described in Section 02513, Bituminous Surface Course. The leveling course shall be placed before the new overlay to assure that the finish course will meet the specified smoothness tolerances.

8. PAINT REMOVAL: The existing painted markings are similar to the new shown on the drawings. The numbers at the runway ends and the fixed distance markers located 1000 feet from each runway end shall have all built-up paint removed. Only paint that is tightly bonded and cannot be removed by reasonable concentrated effort will be permitted to remain.

9. VEGETATION CONTROL: After the patching and paint removal is complete, the area to be overlaid will receive a herbicide treatment as specified in Section 02252, Vegetation Control.

10. CLEANING: All pavements to be overlaid shall be cleaned to expose the existing bituminous surface. All grass, weeds, and other material that would prevent construction of a satisfactory overlay shall be removed.

11. MEASUREMENT AND PAYMENT: All asphaltic concrete mixture used in patches or leveling course shall be measured by the ton and paid for at the applicable unit price of the bid schedule. Payment for all other work described in this section shall be included in the applicable lump sum item of the bid schedule.

END OF SECTION

SECTION 02504

STRESS-ABSORBING MEMBRANE INTERLAYER (SAMI)

1. APPLICABLE PUBLICATIONS: The following publications of the issue listed, but referred thereafter by basic designation only, form a part of this specification.

1.1 American Society for Testing and Materials (ASTM)

D 3381-81	Viscosity-Graded Asphalt Cement for Use in Pavement Construction
E 11-81	Wire-Cloth Sieves for Testing Purposes

2. MATERIAL

2.1 General: Stress-absorbing membrane interlayer (SAMI) will consist of a mixture of hot asphalt cement and ground tire rubber, heated and applied to a pavement surface, and covered with an aggregate where necessary to prepare for a pavement overlay.

2.2 Asphalt: Conform to ASTM D 3381, Table 3, viscosity grade AR 2000 or AR 4000.

2.3 Granulated Rubber: Ground from automotive tires; shall be free from fabric, wire, or other contaminating materials. If mixing procedure includes contact between the hot asphalt and rubber for more than five minutes, 95 percent of the rubber shall pass a No 16 sieve and not more than 10 percent shall pass a No 25 sieve. If the contact period is less than five minutes, 98 percent of the rubber shall pass a No 25 sieve. Sieves shall comply with ASTM E 11.

2.4 Asphalt-Rubber Mix: Proportion by weight shall be 75±2 percent asphalt and 25± percent rubber. Kerosene may be added to adjust viscosity, not to exceed 7-1/2 percent by volume.

2.5 Cover Material: Aggregate used for cover material will be relatively free of clay balls, clay coating, organic matter, or other foreign substances. Maximum size shall be 3/8 inch with not more than five percent passing a No 8 sieve.

3. QUANTITIES TO BE APPLIED

3.1 Asphalt-Rubber Mixture: For interlayer to be overlaid with asphaltic concrete, apply 0.5 to 0.60 gallons per square yard. Adjustment to application rate may be made within these limits by the contracting officer due to varied texture of the existing surfaces.

3.2 Aggregate Cover. Apply only sufficient quantity to permit subsequent paving operations without excessive tracking by construction equipment.

4. EQUIPMENT: Distributors for the asphalt-rubber mix and the aggregate cover shall be specially designed for the purpose and capable of spreading the materials within the specified limits. The asphalt-rubber distributor shall be capable of maintaining a uniform, homogeneous mixture throughout the spreading operation. Materials may be spread by hand in odd-shaped areas.

5. PREPARATION: Apply only when existing pavement is dry. The existing pavements to receive bituminous overlay shall be cleaned, patched, and a herbicide treatment applied as specified in SECTION: PAVEMENT PREPARATION.

6. APPLICATION: Apply materials with distributors specified. Rolling of aggregate cover will be the contractor's option; however, any loose aggregate shall be removed before the overlay is placed. Special care will be taken to prevent excessive buildup of SAMI materials due to overlapping or improper hand applications. The treated surface shall be protected against damage until the overlay is placed.

7. MEASUREMENT AND PAVEMENT: The quantity of asphalt-rubber will be measured and paid for by the 2,000 pound ton of material applied and accepted. Preparation of surface, application of asphalt-rubber mix, and furnishing and applying of aggregate cover will be measured and paid for by the square yard of pavment.

END OF SECTION

ARIZONA REFINING COMPANY
P. O. BOX 1453
PHOENIX, ARIZONA 85001
(602) 258-4843

WATS OUTSIDE ARIZONA (800) 528-5305
INSIDE ARIZONA (800) 352-5331

Arizona Refining Company
Specification M 101-83

SPECIFICATION FOR ARM-R-SHIELD™

1.0 DESCRIPTION

ARM-R-SHIELD is a mixture of asphalt cement, rubber extender oil, and ground rubber blended together at an elevated temperature in the manner, proportions, and sequence herein described.

2.0 MATERIALS

2.1 MODIFIED ASPHALT CEMENT

The asphalt cement shall be a mixture of asphalt and rubber extender oil combined to form a material that is chemically compatible with the rubber.

2.2 RUBBER

a. Composition. The rubber shall be a dry, free flowing blend of powdered reclaimed scrap tire rubber and ground vulcanized rubber. The exact proportions will be determined by our laboratory to maximize the end properties of the product with the rubber available in the area.

b. Purity. The rubber shall contain no more than a trace of fabric, and shall be free of wire and other contaminant materials except that up to 4 percent of a dusting agent such as calcium carbonate or talc may be included to prevent the rubber particles from sticking together.

c. Size. The rubber shall contain no particles larger than 10 mesh or exceeding 0.250 inches in length.

d. Natural Rubber. The blended rubber compound will contain by weight a minimum of 25 percent natural rubber (ASTM D-297).

e. Type. The ground rubber types shall consist of one or a blend of the types indicated below. The ground rubber types shall meet the following gradations:

FLAGSTAFF TERMINAL (602) 774-4587 FREDONIA TERMINAL (602) 643-2614

ARIZONA REFINING COMPANY
P. O. BOX 1453
PHOENIX, ARIZONA 85001
(602) 258-4843

WATS OUTSIDE ARIZONA (800) 528-5306
INSIDE ARIZONA (800) 352-5331

PROCEDURE FOR MANUFACTURE AND PLACEMENT OF ARM-R-SHIELD™ ASPHALT-RUBBER STRESS ABSORBING MEMBRANE INTERLAYER

1. Blend asphalt with rubber extender oil.

2. Heat mixture to 375-425°F.

3. Add rubber to asphalt-extender oil mixture.

4. After addition of the rubber, the product shall be heated to a minimum temperature of 375°F to complete the reaction. Before the product is ready for use, a minimum of 60 minutes must elapse from the time the rubber addition is started.

5. After the reaction is completed, the product may be stored at temperatures between 325°F and 400°F until used. In the event a delay occurs, the heat shall be turned off until the job resumes.

6. Optimum application rate is generally 0.60 ± 0.05 gallons/sq. yd.

7. Tack Coat: due to the highly adhesive nature of the product and possible dilution of properties of the asphalt rubber by tack material, a tack coat before application of the S.A.M.I. is unnecessary and undesirable.

10/83

(The reverse of this page is blank.)

FLAGSTAFF TERMINAL (602) 774-4587 FREDONIA TERMINAL (602) 643-2614

APPENDIX C
DATA REDUCTION AND ANALYSIS--PETERSON AFB

FIELD DATA

Data obtained as part of field crack surveys will be recorded on field sheets (Appendix E). These sheets are divided into 1-foot squares with delineations for 25- by 70-foot areas. It is expected that crack lengths and relative cracking will be recorded directly on these field data sheets. A summary sheet of cracking and relative cracking is included in each packet of field sheets. Analysis of field data is set up on a Multiplan file and a Chart file [Dsk RDP 20(85-1027)].

ANALYSIS PROCEDURE

A. Duplicate the last analysis folder and name (with date).

B. For the file "Section Summary":

1) Remove (cut) old data from the column "Cracking LF" (column 9).

2) Remove (cut) the old "Remarks" (column 12).

3) Enter new "Cracking LF" data in column 9 and appropriate remarks in the "Remarks" column (column 10) for each subsection.

NOTE: Calculations for relative cracking (LF/SQFT) in column 10 are based on full subsections (275 feet for portland cement concrete base--19,250 square foot area) and 135 feet for soil cement bases--9,450 square foot area). If sections are removed such as, say, end transitions, the calculation formula must be modified to account for the revised area under consideration.

C. For the file "Reduced Data Summary":

1) Remove (cut) old data from the column "Cracking LF" (column 9).

2) Enter new "Cracking LF" data in column 9. (See NOTE above.)

D. For the file "Analysis W/O Saw":

1) Remove old data. (*A1*, etc.)

2) Enter new data from "Reduced Data Summary."

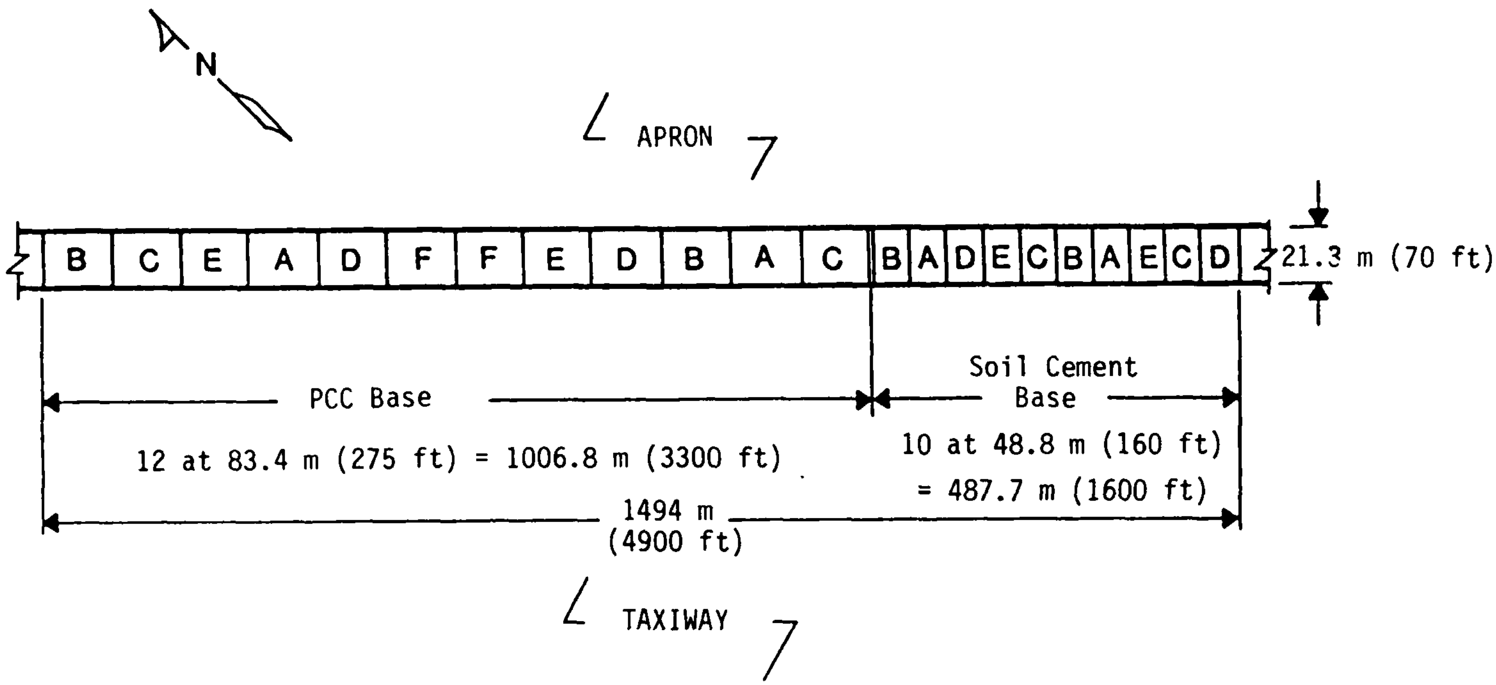
E. For the file "Analysis W/Saw."

1) Remove old data (*A1*, etc.)

2) Enter new data from "Reduced Data Summary."

F. For graphics output:

1) Add new data to the "Values" list in the Chart programs.



Section Designation

A Control [7.6 cm (3 in) A.C.]

B Asphalt-Rubber

C Modified Asphalt-Rubber

D Rubber-Filled A.C.

E Fabric

F Sawed A.C.

Figure C-1. Reflection Crack Control Trial Section Layout, Peterson AFB.

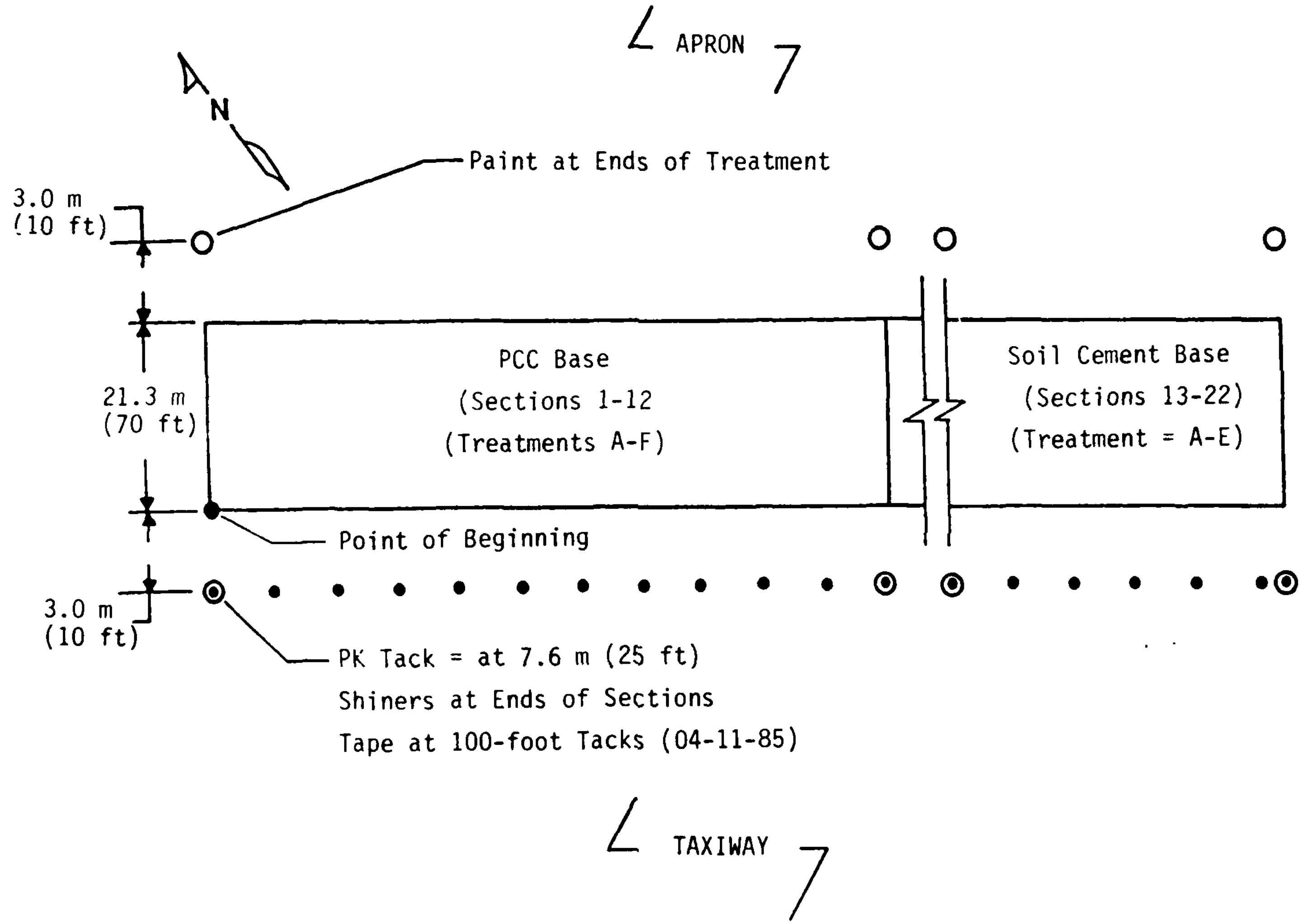


Figure C-2. Reflection Crack Control Trial Sections--Monument Layout, Peterson AFB.

TABLE C-1. ANALYSIS WITHOUT SAWED ASPHALT CONCRETE

BASE, B >	PCC	SOIL CEMENT
TREATMENT, T		
A	REP 1 REP 2	REP 1 REP 2
B	REP 1 REP 2	REP 1 REP 2
C	REP 1 REP 2	REP 1 REP 2
D	REP 1 REP 1	REP 2 REP 2
E	REP 1 REP 1	REP 1 REP 2

ANALYSIS OF VARIANCE

SOURCE	df
B	1
T	4
B X T	4
ERROR	10
TOTAL	19

TABLE C-2. ANALYSIS WITH SAWED ASPHALT CONCRETE

TREAT >	A	B	C	D	E	F
	REP 1 REP 2	REP 1 REP 2	REP 1 REP 2	REP 1 REP 2	REP 1 REP 2	REP 1 REP 2

ANALYSIS OF VARIANCE

SOURCE	df
TREAT	5
ERROR	6
TOTAL	11

TABLE C-3. SECTION SUMMARY (FIELD DATA)--DSK RDP 20 (85-1027)

SUB-SEC.	BASE	DESIG	MAT'L.	BEGIN	END	CRACKING LF	REMARKS
1	PCC	B	FAB.	0+00	2+75		
2	PCC	C	MODA-R	2+75	5+50		
3	PCC	E	A-R	5+50	8+25		
4	PCC	A	CONT	8+25	11+00		
5	PCC	D	RFAC	11+00	13+75		
6	PCC	F	SAW	13+75	16+50		
7	PCC	F	SAW	16+50	19+25		
8	PCC	E	FAB.	19+25	22+00		
9	PCC	D	RFAC	22+00	24+75		
10	PCC	B	A-R	24+75	27+50		
11	PCC	A	CONT	27+50	30+25		
12	PCC	C	MODA-R	30+25	33+00		
13	SC	B	A-R	33+00	34+35		
14	SC	A	CONT	34+35	35+70		
15	SC	D	RFAC	35+70	37+05		
16	SC	E	FAB.	37+05	38+40		
17	SC	C	MODA-R	38+40	39+75		
18	SC	B	A-R	39+75	41+10		
19	SC	A	CONT	41+10	42+45		
20	SC	E	FAB.	42+45	43+80		
21	SC	C	RFAC	43+80	45+15		
22	SC	D	MODA-R	45+15	46+40		

TABLE C-4. SECTION SUMMARY (REPORT)--DSK RDP 20 (85-1027)

SUB- SEC.	BASE	DESIG	MAT'L.	STATION NO. BEGIN	END	CRACKING LF	LF/SQFT	REMARKS
1	PCC	B	FAB.	0+00	2+75		0	
2	PCC	C	MODA-R	2+75	5+50		0	
3	PCC	E	A-R	5+50	8+25		0	
4	PCC	A	CONT	8+25	11+00		0	
5	PCC	D	RFAC	11+00	13+75		0	
6	PCC	F	SAW	13+75	16+50		0	
7	PCC	F	SAW	16+50	19+25		0	
8	PCC	E	FAB.	19+25	22+00		0	
9	PCC	D	RFAC	22+00	24+75		0	
10	PCC	B	A-R	24+75	27+50		0	
11	PCC	A	CONT	27+50	30+25		0	
12	PCC	C	MODA-R	30+25	33+00		0	
13	SC	B	A-R	33+00	34+35		0	
14	SC	A	CONT	34+35	35+70		0	
15	SC	D	RFAC	35+70	37+05		0	
16	SC	E	FAB.	37+05	38+40		0	
17	SC	C	MODA-R	38+40	39+75		0	
18	SC	B	A-R	39+75	41+10		0	
19	SC	A	CONT	41+10	42+45		0	
20	SC	E	FAB.	42+45	43+80		0	
21	SC	C	RFAC	43+80	45+15		0	
22	SC	D	MODA-R	45+15	46+40		0	

TABLE C-5. REDUCED DATA SUMMARY--DSK RDP 20 (85-1027)

SUB-SEC.	BASE	DESIG	MAT'L.	BEGIN	END	CRACKING LF	CRACKING LF/SQFT	PRE- CONST. LF	PRE- CONST. LF/SQFT		PERCENT OF PRE LF	PERCENT OF PRE LF/SQFT	
1	PCC	B	FAB.	0+00	2+75		0		0	*	#DIV/0!	#DIV/0!	*
2	PCC	C	MODA-R	2+75	5+50		0		0	*	#DIV/0!	#DIV/0!	*
3	PCC	E	A-R	5+50	8+25		0		0	*	#DIV/0!	#DIV/0!	*
4	PCC	A	CONT	8+25	11+00		0		0	*	#DIV/0!	#DIV/0!	*
5	PCC	D	RFAC	11+00	13+75		0		0	*	#DIV/0!	#DIV/0!	*
6	PCC	F	SAW	13+75	16+50		0		0	*	#DIV/0!	#DIV/0!	*
7	PCC	F	SAW	16+50	19+25		0		0	*	#DIV/0!	#DIV/0!	*
8	PCC	E	FAB.	19+25	22+00		0		0	*	#DIV/0!	#DIV/0!	*
9	PCC	D	RFAC	22+00	24+75		0		0	*	#DIV/0!	#DIV/0!	*
10	PCC	B	A-R	24+75	27+50		0		0	*	#DIV/0!	#DIV/0!	*
11	PCC	A	CONT	27+50	30+25		0		0	*	#DIV/0!	#DIV/0!	*
12	PCC	C	MODA-R	30+25	33+00		0		0	*	#DIV/0!	#DIV/0!	*
13	SC	B	A-R	33+00	34+35		0		0	*	#DIV/0!	#DIV/0!	*
14	SC	A	CONT	34+35	35+70		0		0	*	#DIV/0!	#DIV/0!	*
15	SC	D	RFAC	35+70	37+05		0		0	*	#DIV/0!	#DIV/0!	*
16	SC	E	FAB.	37+05	38+40		0		0	*	#DIV/0!	#DIV/0!	*
17	SC	C	MODA-R	38+40	39+75		0		0	*	#DIV/0!	#DIV/0!	*
18	SC	B	A-R	39+75	41+10		0		0	*	#DIV/0!	#DIV/0!	*
19	SC	A	CONT	41+10	42+45		0		0	*	#DIV/0!	#DIV/0!	*
20	SC	E	FAB.	42+45	43+80		0		0	*	#DIV/0!	#DIV/0!	*
21	SC	C	RFAC	43+80	45+15		0		0	*	#DIV/0!	#DIV/0!	*
22	SC	D	MODA-R	45+15	46+40		0		0	*	#DIV/0!	#DIV/0!	*

TABLE C-6. ANALYSIS WITHOUT SAW--DSK RDP 20 (85-1027) DATE________

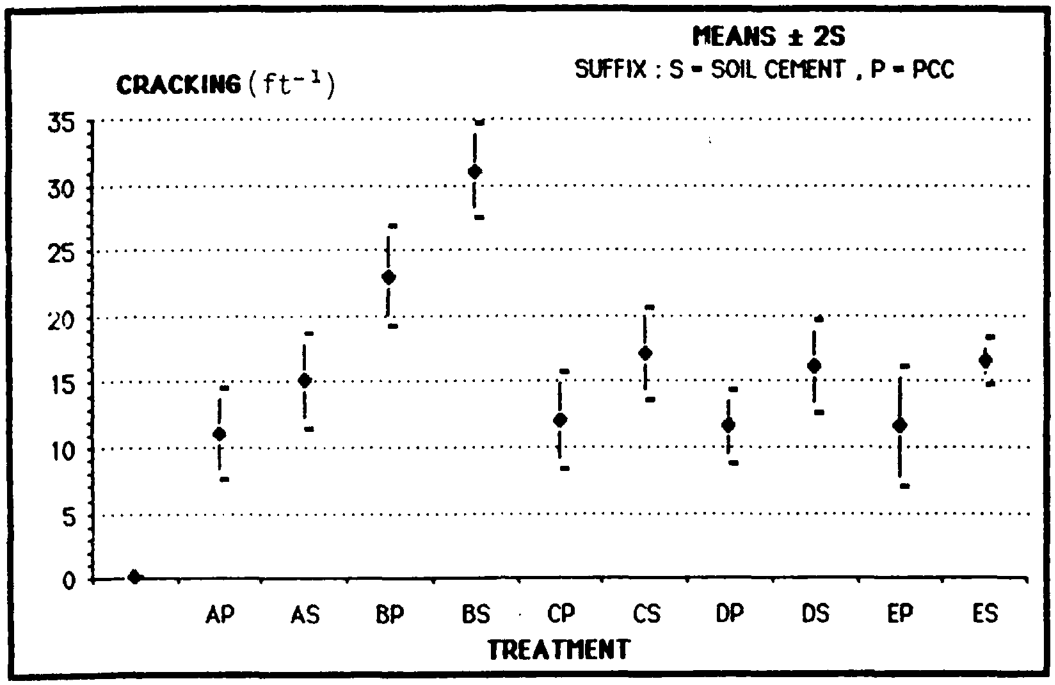
	TREAT,T	>	A CONT.	B A-R	C MODA-R	D RFAC	E FAB.		TOTAL
BASE,B									
PCC:									
REP 1			*A1*	*B1*	*C1*	*D1*	*E1*		
REP 2			*A2*	*B2*	*C2*	*D2*	*E2*		
	TOT		#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!		#VALUE!
	XBAR		#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!		
	RANGE		#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!		
	S=.886R		#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!		
	SS 1		#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!		
SC:									
REP 1			*A1*	*B1*	*C1*	*D1*	*E1*		
REP 2			*A2*	*B2*	*C2*	*D2*	*E2*		
	TOT		#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!		#VALUE!
	XBAR		#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!		
	RANGE		#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!		
	S=.886R		#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!		
	SS 1		#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!		
	TOTALS		#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!		#VALUE!
******	*******	***	******	******	******	******	******	******	******
q TEST			SUM S2=	#VALUE!		SUM S4=	#VALUE!		
	q =					#VALUE!			
	q.999		(p=10)	(v=1)	=	0.694			
	q.99		(p=10)	(v=1)	=	0.528			
******	*******	***	******	******	******	******	******	******	******
ANOVA			CT=	#VALUE!					
	SOURCE	df	SS		MS		F	F .05	F .01
	BASE	1	#VALUE!		#VALUE!		#VALUE!	4.96	10.04
	TREAT	4	#VALUE!		#VALUE!		#VALUE!	3.48	5.99
	B X T	4	#VALUE!		#VALUE!		#VALUE!	3.48	5.99
	ERROR	10	#VALUE!		#VALUE!		---	---	---
	TOTAL	19	#VALUE!		---		---	---	---
******	*******	***	******	******	******	******	******	******	******

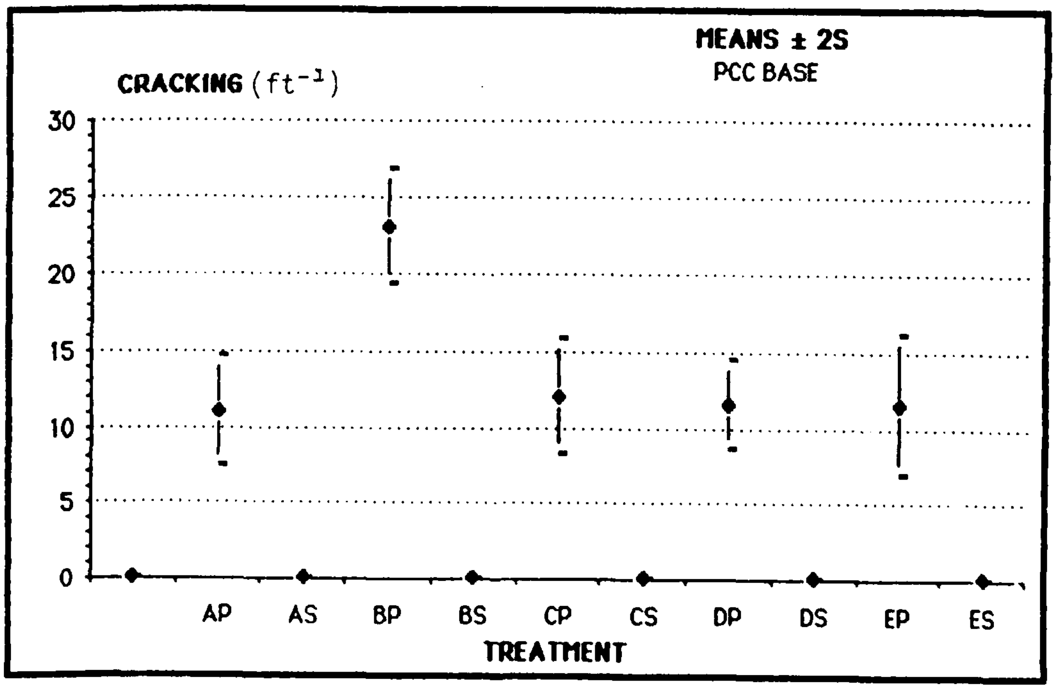
TABLE C-7. ANALYSIS WITHOUT SAW--DSK RDP 20 (85-1027) DATE________

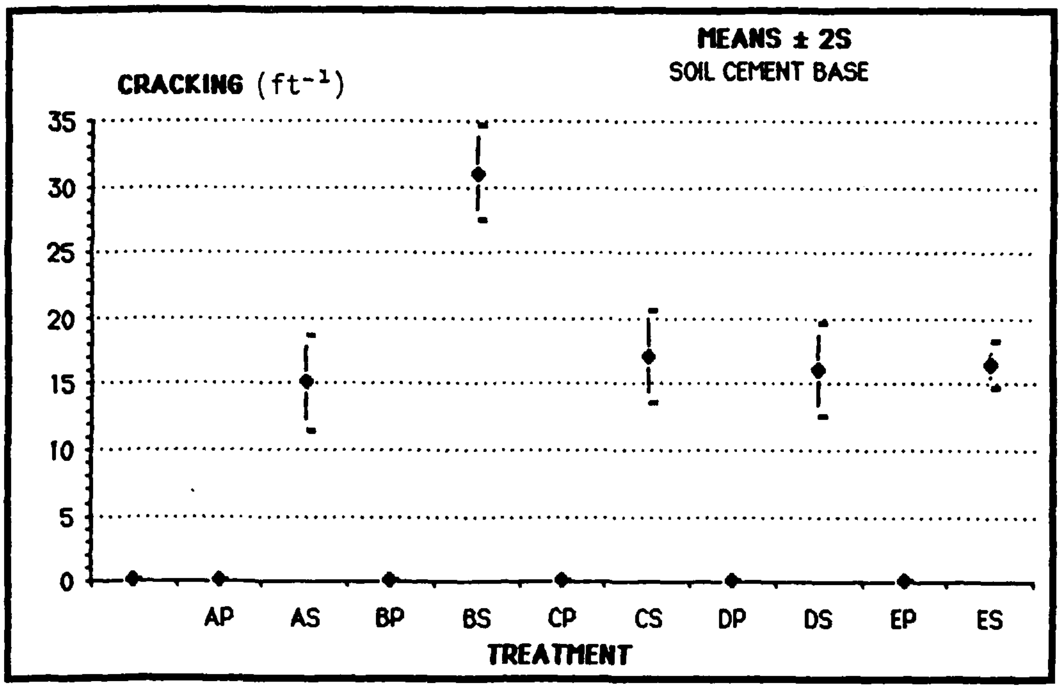
PLOT:		A	B	C	D	E
PCC:						
	XBAR	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
	S	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
	2S	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
	X + 2S	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
	X - 2S	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
SC:						
	XBAR	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
	S	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
	2S	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
	X+2S	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
	X-2S	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!

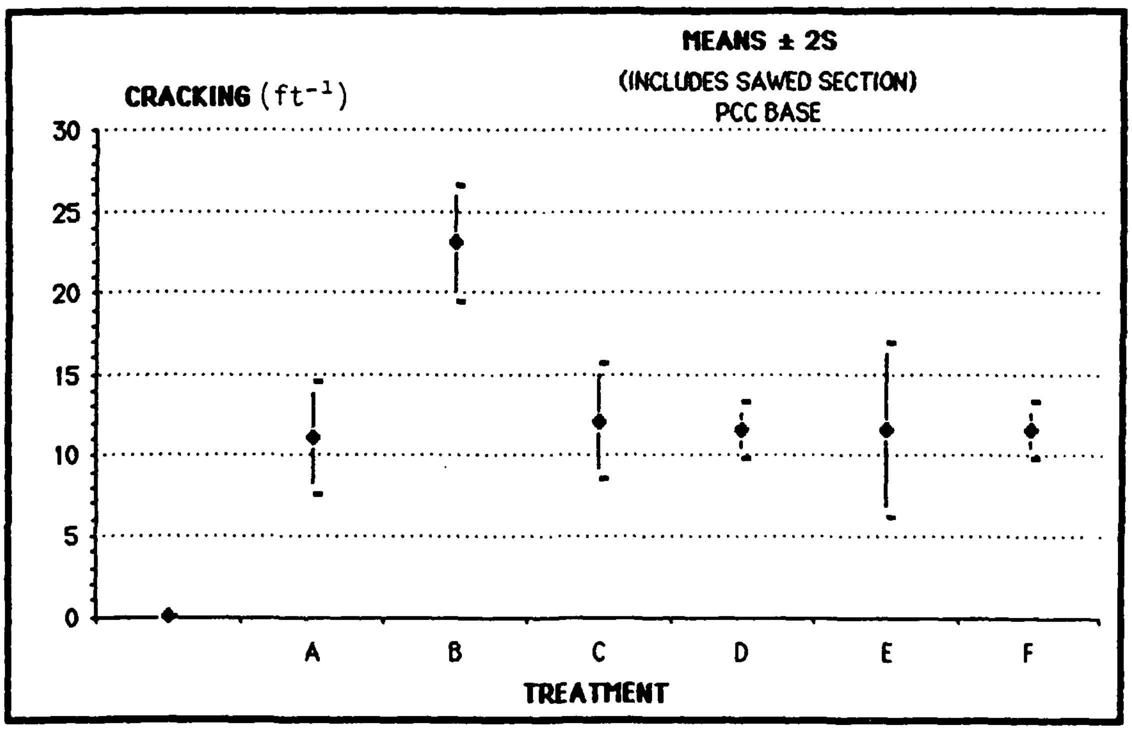
TABLE C-8. ANALYSIS WITH SAW--DSK RDP 20 (85-1027) DATE__________

TREATMENT	>	A CONT.	B A-R	C MODA-R	D RFAC	E FAB.	F SAW		TOTAL
REP 1		*A1*	*B1*	*C1*	*D1*	*E1*	*F1*		
REP 2		*A2*	*B2*	*C2*	*D2*	*E2*	*F2*		
TOTAL		#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!		#VALUE!
X BAR		#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!		
RANGE		#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!		
S=.886R		#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!		
SS 1		#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!		#VALUE!
*********	***	******	******	******	******	******	******	**	******
q TEST		SUM S2=	#VALUE!		SUM S4=	#VALUE!			
q =					#VALUE!				
q.999		(p=6)	(v=1)		0.949				
q.99		(p=6)	(v-1)		0.744				
*********	***	******	******	******	******	******	******	**	******
ANOVA		CT=	#VALUE!						
SOURCE	df	SS		MS		F	F.05		F.01
TREAT.	5	#VALUE!		#VALUE!		#VALUE!	4.39		8.75
ERROR	6	#VALUE!		#VALUE!		---	---		---
TOTAL	11	#VALUE!		---		---	---		---
*********	***	******	******	******	******	******	******	**	******
PLOT :		A	B	C	D	E	F		
XBAR		#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!		
S		#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!		
2S		#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!		
X + 2S		#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!		
X - 2S		#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!		
*********	***	******	******	******	******	******	******	**	******


MEANS ± 2S
SUFFIX : S = SOIL CEMENT , P = PCC
CRACKING (ft⁻¹)
35
30
25
20
15
10
5
0
AP
AS
BP
BS
CP
CS
DP
DS
EP
ES
TREATMENT


MEANS ± 2S
PCC BASE
CRACKING (ft⁻¹)
30
25
20
15
10
5
0
AP
AS
BP
BS
CP
CS
DP
DS
EP
ES
TREATMENT


MEANS ± 2S
SOIL CEMENT BASE
CRACKING (ft⁻¹)
35
30
25
20
15
10
5
0
AP
AS
BP
BS
CP
CS
DP
DS
EP
ES
TREATMENT


MEANS ± 2S
(INCLUDES SAWED SECTION)
PCC BASE
CRACKING (ft⁻¹)
30
25
20
15
10
5
0
A
B
C
D
E
F
TREATMENT

PETERSON AFB ORIGINAL CRACK COUNT. PCC BASE.

SECTION 1

FROM	TO	TOTAL COUNT (Ft.)	RELATIVE COUNT (1/Ft.)
0+00	0+25	341	0.195
0+25	0+50	459	0.262
0+50	0+75	445	0.254
0+75	1+00	321	0.183
1+00	1+25	272	0.155
1+25	1+50	277	0.158
1+50	1+75	234	0.134
1+75	2+00	308	0.176
2+00	2+25	259	0.148
2+25	2+50	219	0.125
2+50	2+75	282	0.161
	TOTAL	3417	1.953
	MEAN	310.6	0.1775
	S.DEV (S)	78.41	0.04481
	2S	156.82	0.08961
	X+2S	467.5	0.267
	X-2S	153.8	0.088

SECTION 2

FROM	TO	TOTAL COUNT (Ft.)	RELATIVE COUNT (Ft.)
2+75	3+00	289	0.165
3+00	3+25	212	0.121
3+25	3+50	292	0.167
3+50	3+75	300	0.171
3+75	4+00	243	0.139
4+00	4+25	336	0.192
4+25	4+50	204	0.117
4+50	4+75	241	0.138
4+75	5+00	285	0.163
5+00	5+25	188	0.107
5+25	5+50	106	0.061
	TOTAL	2696	1.541
	MEAN	245.1	0.1401
	S.DEV (S)	65.12	0.03721
	2S	130.25	0.07443
	X+2S	375.3	0.214
	X-2S	114.8	0.066

Dsk RDP 40 (86-1143).

PETERSON AFB ORIGINAL CRACK COUNT. PCC BASE.

SECTION 3

FROM	TO	TOTAL COUNT (Ft.)	RELATIVE COUNT (1/Ft.)
5+50	5+75	115	0.066
5+75	6+00	74	0.042
6+00	6+25	57	0.033
6+25	6+50	85	0.049
6+50	6+75	68	0.039
6+75	7+00	89	0.051
7+00	7+25	74	0.042
7+25	7+50	90	0.051
7+50	7+75	57	0.033
7+75	8+00	84	0.048
8+00	8+25	199	0.114
	TOTAL	992	0.567
	MEAN	90.2	0.0515
	S.DEV (S)	39.68	0.02267
	2S	79.35	0.04534
	X+2S	169.5	0.097
	X-2S	10.8	0.006

SECTION 4

FROM	TO	TOTAL COUNT (Ft.)	RELATIVE COUNT (Ft.)
8+25	8+50	252	0.144
8+50	8+75	299	0.171
8+75	9+00	264	0.151
9+00	9+25	224	0.128
9+25	9+50	284	0.162
9+50	9+75	374	0.214
9+75	10+00	369	0.211
10+00	10+25	304	0.174
10+25	10+50	311	0.178
10+50	10+75	393	0.225
10+75	11+00	537	0.307
	TOTAL	3611	2.063
	MEAN	328.3	0.1876
	S.DEV (S)	87.20	0.04983
	2S	174.39	0.09965
	X+2S	502.7	0.287
	X-2S	153.9	0.088

Dsk RDP 40 (86-1143).

PETERSON AFB ORIGINAL CRACK COUNT. PCC BASE.

SECTION 5

FROM	TO	TOTAL COUNT (Ft.)	RELATIVE COUNT (1/Ft.)
11+00	11+25	476	0.272
11+25	11+50	215	0.123
11+50	11+75	209	0.119
11+75	12+00	227	0.130
12+00	12+25	250	0.143
12+25	12+50	274	0.157
12+50	12+75	324	0.185
12+75	13+00	228	0.130
13+00	13+25	329	0.188
13+25	13+50	327	0.187
13+50	13+75	353	0.202
	TOTAL	3212	1.835
	MEAN	292.0	0.1669
	S.DEV (S)	80.26	0.04586
	2S	160.53	0.09173
	X+2S	452.5	0.259
	X-2S	131.5	0.075

SECTION 6

FROM	TO	TOTAL COUNT (Ft.)	RELATIVE COUNT (Ft.)
13+75	14+00	100	0.057
14+00	14+25	200	0.114
14+25	14+50	330	0.189
14+50	14+75	396	0.226
14+75	15+00	311	0.176
15+00	15+25	241	0.138
15+25	15+50	281	0.161
15+50	15+75	247	0.141
15+75	16+00	228	0.130
16+00	16+25	308	0.176
16+25	16+50	291	0.166
	TOTAL	2933	1.676
	MEAN	266.6	0.1524
	S.DEV (S)	77.44	0.04425
	2S	154.88	0.06851
	X+2S	421.5	0.241
	X-2S	111.8	0.064

PETERSON AFB ORIGINAL CRACK COUNT. PCC BASE.

SECTION	7			SECTION	8		
FROM	TO	TOTAL COUNT (Ft.)	RELATIVE COUNT (1/Ft.)	FROM	TO	TOTAL COUNT (Ft.)	RELATIVE COUNT (Ft.)
16+50	16+75	211	0.121	19+25	19+50	287	0.164
16+75	17+00	315	0.180	19+50	19+75	213	0.122
17+00	17+25	253	0.145	19+75	20+00	325	0.186
17+25	17+50	242	0.138	20+00	20+25	159	0.091
17+50	17+75	221	0.126	20+25	20+50	123	0.070
17+75	18+00	222	0.127	20+50	20+75	127	0.073
18+00	18+25	205	0.117	20+75	21+00	143	0.082
18+25	18+50	234	0.134	21+00	21+25	112	0.064
18+50	18+75	350	0.200	21+25	21+50	169	0.097
18+75	19+00	205	0.117	21+50	21+75	141	0.081
19+00	19+25	310	0.177	21+75	22+00	165	0.094
	TOTAL	2768	1.582		TOTAL	1964	1.122
	MEAN	251.6	0.1438		MEAN	178.5	0.1020
	S.DEV (S)	50.32	0.02875		S.DEV (S)	69.21	0.03955
	2S	100.64	0.05751		2S	138.42	0.0791
	X+2S	352.3	0.201		X+2S	317.0	0.181
	X-2S	151.0	0.086		X-2S	40.1	0.023

PETERSON AFB ORIGINAL CRACK COUNT. PCC BASE.

SECTION 9

FROM	TO	TOTAL COUNT (Ft.)	RELATIVE COUNT (1/Ft.)
22+00	22+25	347	0.198
22+25	22+50	309	0.177
22+50	22+75	243	0.139
22+75	23+00	284	0.162
23+00	23+25	299	0.171
23+25	23+50	222	0.127
23+50	23+75	260	0.149
23+75	24+00	258	0.147
24+00	24+25	174	0.099
24+25	24+50	286	0.163
24+50	24+75	253	0.145
	TOTAL	2935	1.677
	MEAN	266.8	0.1525
	S.DEV (S)	46.27	0.02644
	2S	92.55	0.05289
	X+2S	359.4	0.205
	X-2S	174.3	0.100

SECTION 10

FROM	TO	TOTAL COUNT (Ft.)	RELATIVE COUNT (Ft.)
24+75	25+00	183	0.105
25+00	25+25	216	0.123
25+25	25+50	275	0.157
25+50	25+75	211	0.121
25+75	26+00	271	0.155
26+00	26+25	268	0.153
26+25	26+50	179	0.102
26+50	26+75	280	0.160
26+75	27+00	254	0.145
27+00	27+25	187	0.107
27+25	27+50	237	0.135
	TOTAL	2561	1.463
	MEAN	232.8	0.1330
	S.DEV (S)	39.25	0.02243
	2S	78.49	0.04405
	X+2S	311.3	0.178
	X-2S	154.3	0.088

Dsk RDP 40 (86-1143).

PETERSON AFB ORIGINAL CRACK COUNT SUMMARY. PCC BASE.

SECTION	TOTAL COUNT (Ft.)	SECTION	AVE. REL. COUNT (1/Ft.)
1	3417	1	0.1775
2	2696	2	0.1401
3	992	3	0.0515
4	3611	4	0.1876
5	3212	5	0.1669
6	2933	6	0.1524
7	2768	7	0.1438
8	1964	8	0.102
9	2935	9	0.1525
10	2561	10	0.133
11	2519	11	0.1309
12	2194	12	0.114
TOTAL	31802	TOTAL	1.6522
MEAN	2650.2	MEAN	0.1377

Dsk RDP 40 (86-1143).

PETERSON AFB ORIGINAL CRACK COUNT SUMMARY. PCC BASE.

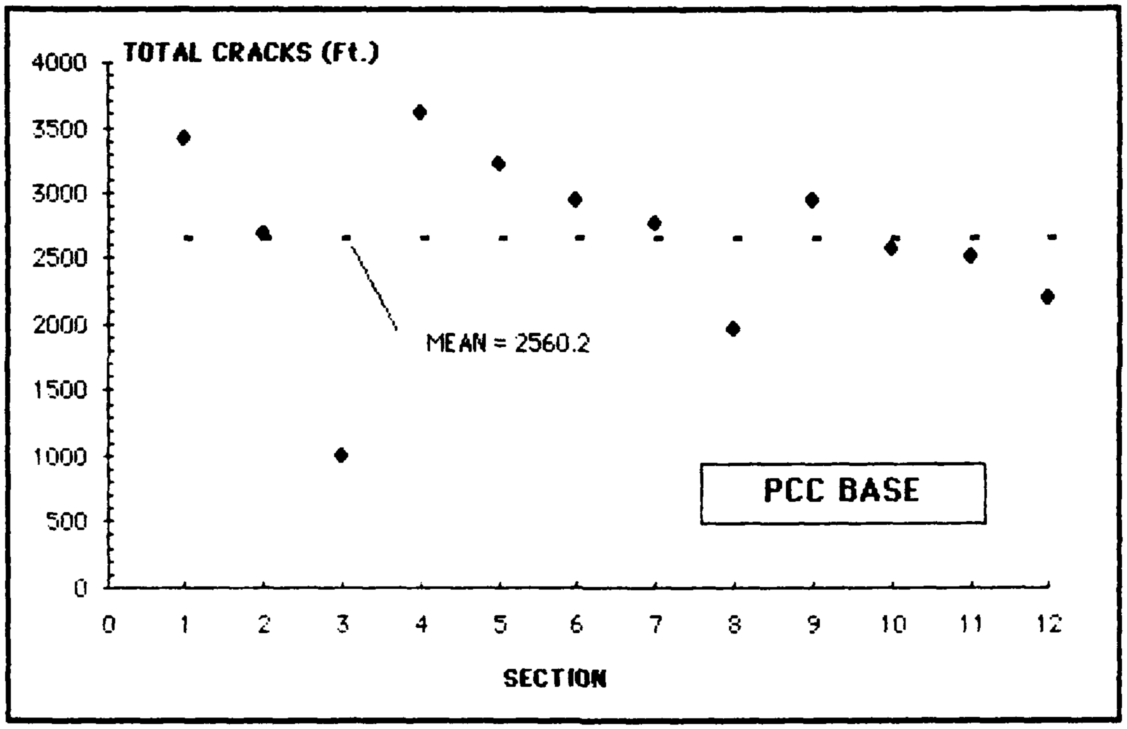
PLOTTING POINTS.

SECTION	TOTAL COUNT (Ft.)
1	3417
2	2696
3	992
4	3611
5	3212
6	2933
7	2768
8	1964
9	2935
10	2561
11	2519
12	2194
TOTAL	31802
MEAN	2650.2

SECTION	AVE. REL. COUNT (1/Ft.)
1	0.1775
2	0.1401
3	0.0515
4	0.1876
5	0.1669
6	0.1524
7	0.1438
8	0.102
9	0.1525
10	0.133
11	0.1309
12	0.114
TOTAL	1.6522
MEAN	0.1377

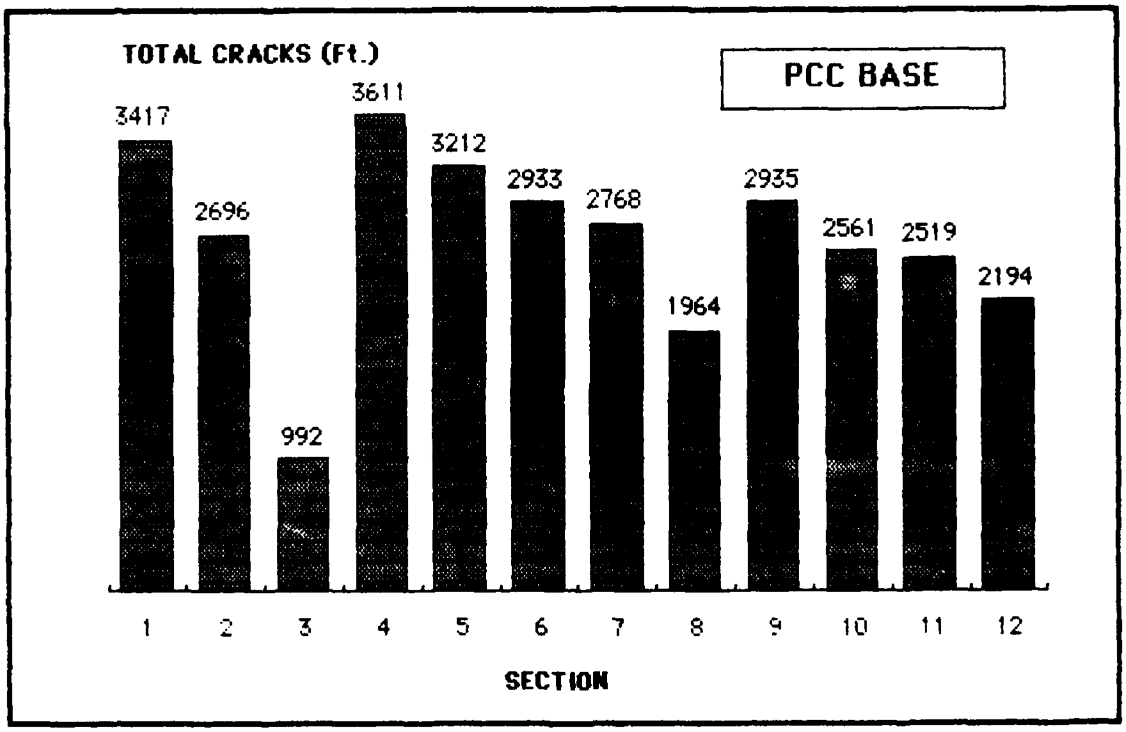
Dsk RDP 40 (86-1143).

PETERSON AFB ORIGINAL CRACK COUNT. PCC BASE.



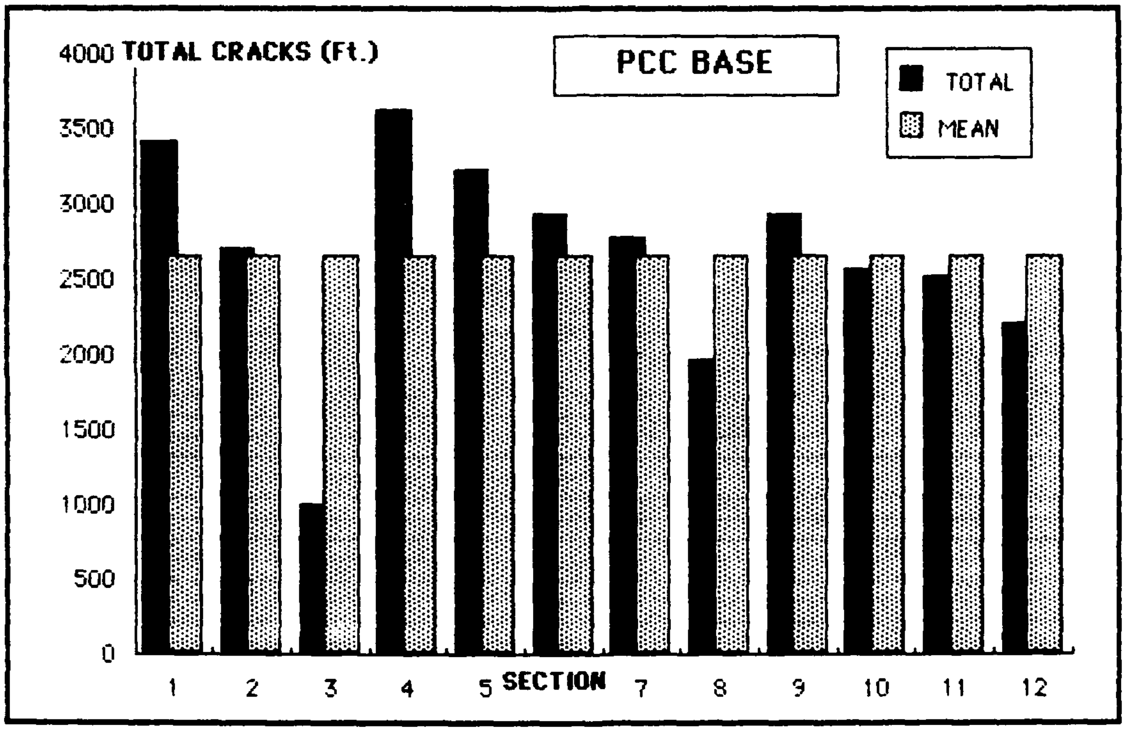
Dsk RDP 40 (86-1143).

PETERSON AFB ORIGINAL CRACK COUNT. PCC BASE.



Dsk RDP 40 (86-1143)

PETERSON AFB ORIGINAL CRACK COUNT. PCC BASE.



PETERSON AFB ORIGINAL CRACK COUNT. SOIL CEMENT BASE.

SECTION 13				SECTION 14			
FROM	TO	TOTAL COUNT (Sq. Ft.)	RELATIVE COUNT (Sq. Ft. per Sq. Ft.)	FROM	TO	TOTAL COUNT (Ft.)	RELATIVE COUNT (Sq. Ft. per Sq. Ft.)
33+00	33+25	1375	0.786	34+35	34+60	1400	0.800
33+25	33+50	750	0.429	34+60	34+85	1300	0.743
33+50	33+75	400	0.229	34+85	35+10	1000	0.571
33+75	34+00	750	0.429	35+10	35+35	1100	0.629
34+00	34+35	900	0.367	35+35	35+70	1200	0.490
	TOTAL	4175	2.239		TOTAL	6000	3.233
	MEAN	835.0	0.4478		MEAN	1200.0	[illegible]
	S.DEV (S)	353.38	0.20563		DEV(S)	158.11	0.12586
	2S	706.75	0.41165		2S	316.23	0.25171
	X+2S	1541.8	0.859		X+2S	1516.2	0.898
	X-2S	128.2	0.036		X-2S	883.8	0.395

Dsk RDP 40 (86-1145).

PETERSON AFB ORIGINAL CRACK COUNT. SOIL CEMENT BASE.

SECTION 15

FROM	TO	TOTAL COUNT (Sq. Ft.)	RELATIVE COUNT (Sq. Ft. per Sq. Ft.)
35+70	35+95	1400	0.812
35+95	36+20	1325	0.768
36+20	36+45	1225	0.710
36+45	36+70	1100	0.638
36+70	37+05	1200	0.490
	TOTAL	6250	3.417
	MEAN	1250.0	0.6835
	S.DEV (S)	115.92	0.12639
	2S	231.84	0.25278
	X+2S	1481.8	0.936
	X-2S	1018.2	0.431

SECTION 16

FROM	TO	TOTAL COUNT (Ft.)	RELATIVE COUNT (Sq. Ft. per Sq. Ft.)
37+05	37+30	1325	0.768
37+30	37+55	1375	0.797
37+55	37+80	1250	0.725
37+80	38+05	1300	0.754
38+05	38+40	850	0.347
	TOTAL	6100	3.390
	MEAN	1220.0	0.6781
	DEV(S)	211.69	0.18695
	2S	423.38	0.3739
	X+2S	1643.4	1.052
	X-2S	796.6	0.304

Dsk RDP 40 (86-1145).

PETERSON AFB ORIGINAL CRACK COUNT. SOIL CEMENT BASE.

SECTION 17

FROM	TO	TOTAL COUNT (Sq. Ft.)	RELATIVE COUNT (Sq. Ft. per Sq. Ft.)
38+40	38+65	1200	0.686
38+65	38+90	1175	0.671
38+90	39+15	1200	0.686
39+15	39+40	1300	0.743
39+40	39+75	1350	0.551
	TOTAL	6225	3.337
	MEAN	1245.0	0.6673
	S.DEV (S)	75.83	0.07058
	2S	151.66	0.14116
	X+2S	1396.7	0.809
	X-2S	1093.3	0.526

SECTION 18

FROM	TO	TOTAL COUNT (Ft.)	RELATIVE COUNT (Sq. Ft. per Sq. Ft.)
39+75	40+00	1250	0.714
40+00	40+25	1300	0.743
40+25	40+50	1250	0.714
40+50	40+75	1325	0.757
40+75	41+10	1375	0.561
	TOTAL	6500	3.490
	MEAN	1300.0	0.6980
	DEV(S)	53.03	0.07866
	2S	106.07	0.15732
	X+2S	1406.1	0.855
	X-2S	1193.9	0.541

Dsk RDP 40 (86-1145).

PETERSON AFB ORIGINAL CRACK COUNT. SOIL CEMENT BASE.

SECTION 19

FROM	TO	TOTAL COUNT (Sq. Ft.)	RELATIVE COUNT (Sq. Ft. per Sq. Ft.)
41+10	41+35	1400	0.800
41+35	41+60	1300	0.743
41+60	41+85	1375	0.786
41+85	42+10	1325	0.757
42+10	42+45	1350	0.551
	TOTAL	6750	3.637
	MEAN	1350.0	0.7273
	S.DEV (S)	39.53	0.10112
	2S	79.06	0.20225
	X+2S	1429.1	0.930
	X-2S	1270.9	0.525

SECTION 20

FROM	TO	TOTAL COUNT (Ft.)	RELATIVE COUNT (Sq. Ft. per Sq. Ft.)
42+45	42+70	1300	0.743
42+70	42+95	1250	0.714
42+95	43+20	1275	0.729
43+20	43+45	1250	0.714
43+45	43+80	1375	0.561
	TOTAL	6450	3.461
	MEAN	1290.0	0.6922
	DEV(S)	51.84	0.07419
	2S	103.68	0.14839
	X+2S	1393.7	0.841
	X-2S	1186.3	0.544

PETERSON AFB ORIGINAL CRACK COUNT. SOIL CEMENT BASE.

SECTION 21			
FROM	TO	TOTAL COUNT (Sq. Ft.)	RELATIVE COUNT (Sq. Ft. per Sq. Ft.)
43+80	44+05	1100	0.629
44+05	44+30	1225	0.700
44+30	44+55	1200	0.686
44+55	44+80	1100	0.629
44+80	45+15	1250	0.510
	TOTAL	5875	3.153
	MEAN	1175.0	0.6306
	S.DEV (S)	70.71	0.07476
	2S	141.42	0.14952
	X+2S	1316.4	0.780
	X-2S	1033.6	0.481

SECTION 22			
FROM	TO	TOTAL COUNT (Ft.)	RELATIVE COUNT (Sq. Ft. per Sq. Ft.)
45+15	45+40	1200	0.686
45+40	45+65	1250	0.714
45+65	45+90	1075	0.614
45+90	46+15	900	0.514
46+15	46+60	750	0.306
	TOTAL	5175	2.835
	MEAN	1035.0	0.5669
	DEV(S)	208.87	0.16497
	2S	417.73	0.32994
	X+2S	1452.7	0.897
	X-2S	617.3	0.237

Dsk RDP 40 (86-1145).

PETERSON AFB ORIGINAL CRACK COUNT SUMMARY. SOIL CEMENT BASE.

SECTION	TOTAL COUNT (Sq. Ft.)	SECTION	RELATIVE COUNT (Sq. Ft. per Sq/ Ft.)
13	4175	13	0.4478
14	6000	14	0.6465
15	6250	15	0.6835
16	6100	16	0.6781
17	6225	17	0.6673
18	6500	18	0.698
19	6750	19	0.7273
20	6450	20	0.6922
21	5875	21	0.6306
22	5175	22	0.5669
TOTAL	59500	TOTAL	6.4382
MEAN	5950	MEAN	0.64382

Dsk RDP 40 (86-1145).

PETERSON AFB ORIGINAL CRACK COUNT SUMMARY. SOIL CEMENT BASE.

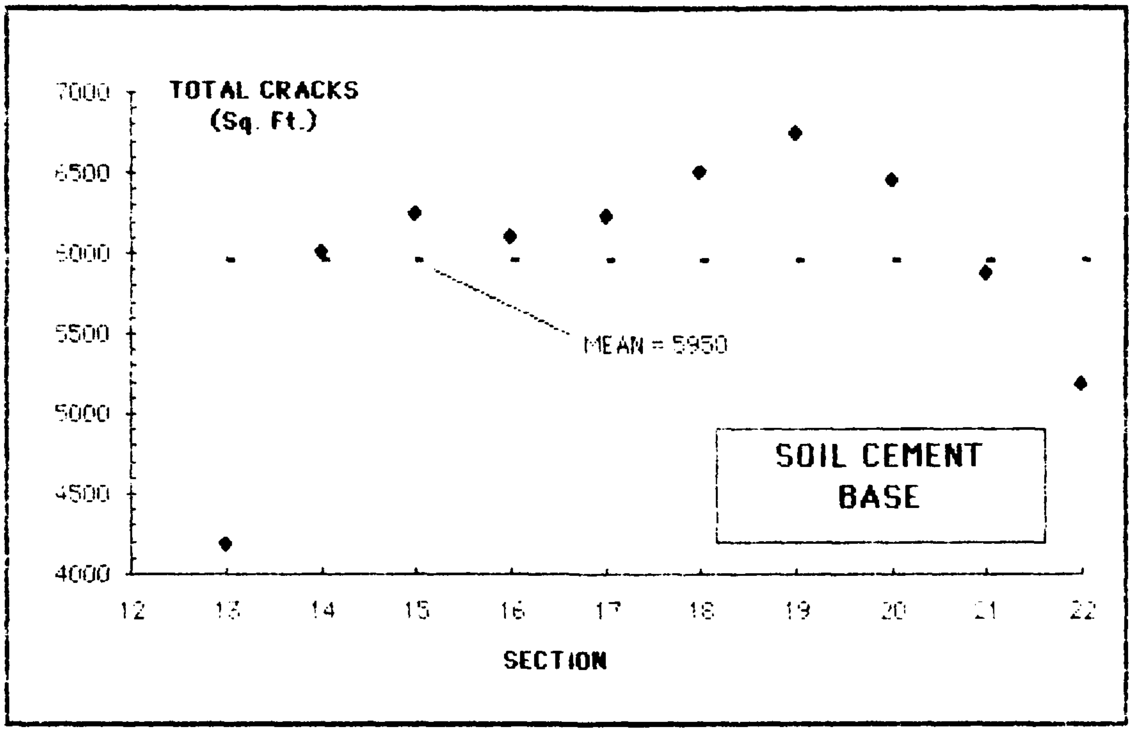
.OTTING POINTS.

SECTION	TOTAL COUNT (Sq. Ft.)
13	4175
14	6000
15	6250
16	6100
17	6225
18	6500
19	6750
20	6450
21	5875
22	5175
TOTAL	59500
MEAN	5950

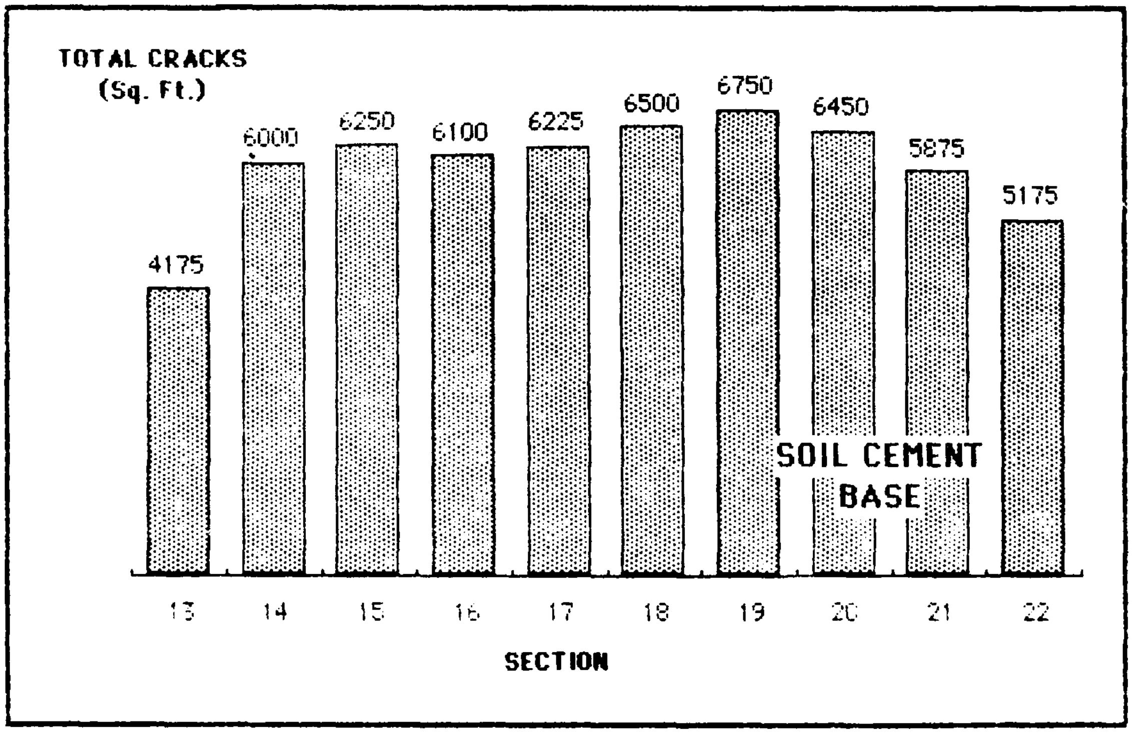
SECTION	RELATIVE COUNT (Sq. Ft. per Sq/ Ft.)
13	0.4478
14	0.6465
15	0.6835
16	0.6781
17	0.6673
18	0.698
19	0.7273
20	0.6922
21	0.6306
22	0.5669
TOTAL	6.4382
MEAN	0.64382

Dsk RDP 40 (86-1145).

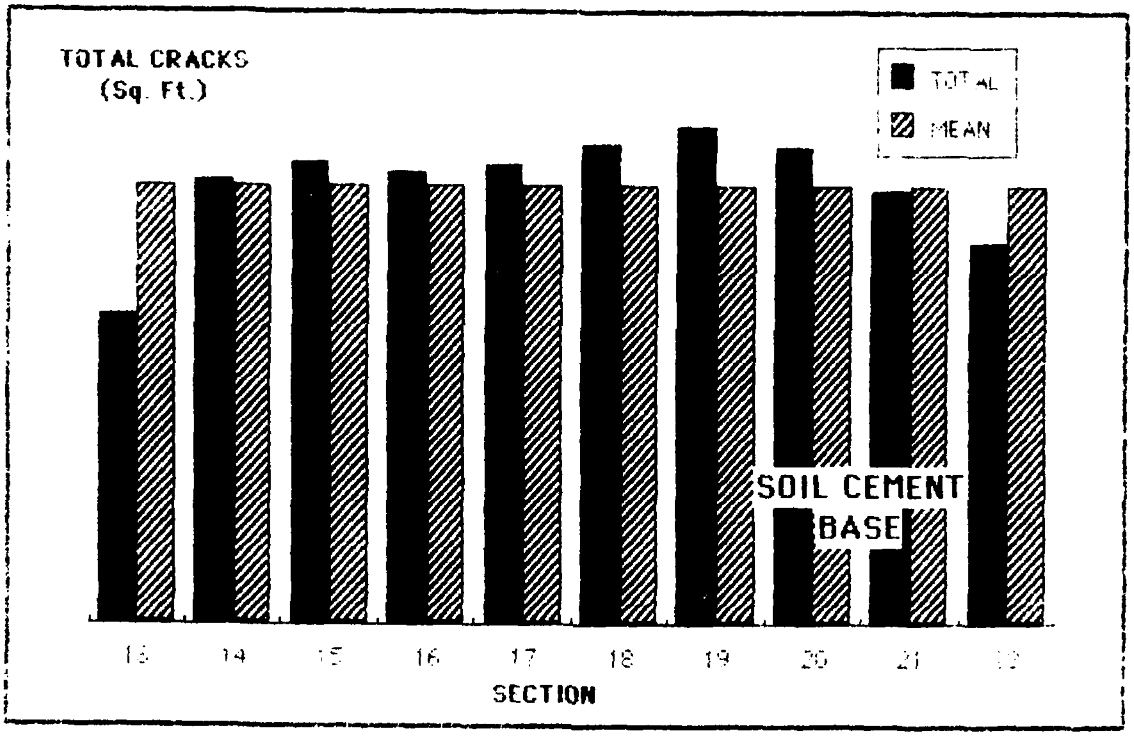
PETERSON AFB ORIGINAL CRACK COUNT. SOIL CEMENT BASE



PETERSON AFB ORIGINAL CRACK COUNT. SOIL CEMENT BASE



PETERSON AFB ORIGINAL CRACK COUNT SOIL CEMENT BASE



ESK RDP 40 (86-1145)

(The reverse of this page is blank.)

APPENDIX D

APPLICABLE SPECIFICATION SECTIONS--PETERSON AFB

Section D-1	Bituminous Intermediate and Wearing Courses For Airfields, Heliports, and Heavy-Duty Pavements
Section D-2	Asphalt-Rubber Surface Treatment or Interlayer
Section D-3	Polymer Modified Asphalt-Rubber Surface Treatment or Interlayer
Section D-4	Rubber-Filled Asphalt-Concrete
Section D-5	Polypropylene Pavement Reinforcing Fabric
Section D-6	Cold Milling

SUMMARY OF KEY SPECIFICATION ITEMS

SECTION PARA	ITEM	ITEM DESCRIPTION
D-1, 7.1	Samples	Hot-Mix Aggregates
D-1, 7.2	Certificate	Hot-Mix Aggregate Source Approval
D-1, 8.1.1	Samples	Hot-Mix Field Samples
D-1, 10	Certificates	Waybills and Delivery Tickets for Aggregates and Bituminous Materials
D-1, 14.1.4	Certificates	Hot-Mix Aggregate Quality
D-1, 14.4	Approval	Antistripping Agent (if used)
D-1, 16.1	Mixture Design	Job-Mix Formula (JMF)
D-2, 3.7	Certificates	Specification Compliance for Asphalt-Rubber
D-2, 5.3	Letter	Job Delay and Holdover Times
D-3, 3.3	Certificates	Specification Compliance for Modified Asphalt-Rubber
D-3, 5.3	Letter	Reference 3B-5.3; Job Delay and Holdover Times
D-4, 3	Mixture Design	Job-Mix Formula (JMF) for Rubber Filled Asphalt Concrete
D-4, 3.2	Samples	Asphalt Cement and Rubber Samples
D-4, 5	Samples	Aggregate Samples
D-5, 3	Certificate	Specification Compliance of Polypropylene Pavement Reinforcing Fabric

- END -

Dsk RDP 16 (85-1013)
Submittals.

SECTION D-1

BITUMINOUS INTERMEDIATE AND WEARING COURSES FOR AIRFIELDS, HELIPORTS, AND HEAVY-DUTY PAVEMENTS (CENTRAL-PLANT HOT-MIX)

PART 1 - GENERAL

1. APPLICABLE PUBLICATIONS
2. PLANT, EQUIPMENT, MACHINES, AND TOOLS
3. MIXING PLANTS
4. WEATHER LIMITATIONS
5. PROTECTION OF PAVEMENT
6. GRADE AND SURFACE SMOOTHNESS REQUIREMENTS
7. AGGREGATE SAMPLING AND TESTING
8. ACCEPTABILITY OF WORK
9. ACCESS TO PLANT AND EQUIPMENT
10. WAYBILLS AND DELIVERY TICKETS
11. MEASUREMENT
12. PAYMENT

PART 2 - PRODUCTS

13. BITUMINOUS HOT MIX
14. PROPERTIES OF AGGREGATES, BITUMINOUS MATERIALS, AND BITUMINOUS MIXTURES
15. DELIVERY, STORAGE, AND HANDLING OF MATERIALS
16. PROPORTIONING OF MIXTURE

PART 3 - EXECUTION

17. CONDITIONING OF BASE COURSE OR EXISTING PAVEMENT
18. GRADE CONTROL
19. PREPARATION OF MINERAL AGGREGATES
20. PREPARATION OF BITUMINOUS MIXTURES
21. WATER CONTENT OF AGGREGATE
22. STORAGE OF BITUMINOUS PAVING MIXTURE
23. TRANSPORTATION OF BITUMINOUS MIXTURE
24. PLACING
25. COMPACTION OF MIXTURE
26. JOINTS

Dsk RDP 16 (85-1012)

PART 1 - GENERAL

1. APPLICABLE PUBLICATIONS: The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

1.1 Military Standard (MIL-STD):

MIL-STD 620A & Notice 1	Test Methods for Bituminous Paving Materials

1.2 U.S. Army Corps of Engineers, Handbook for Concrete and Cement:

CRD-C 119-53 Rev. June 63	Flat and Elongated Particles in Coarse Aggregate

1.3 American Society for Testing and Materials (ASTM) Publications:

C 29-78	Unit Weight and Voids in Aggregate
C 88-76	Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
C 127-81	Specific Gravity and Absorption of Coarse Aggregate
C128-79	Specific Gravity and Absorption of Fine Aggregate
C 131-81	Resistance to Degradation of Small Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
C 136-82	Sieve Analysis of Fine and Coarse Aggregates
C 183-78	Sampling Hydraulis Cement

Dsk RDP 16 (85-1012)

D 5-73 (R 1978)	Penetration of Bituminous Materials
D 75-82	Sampling Aggregate
D 140-70 (R 1981)	Sampling Bituminous Materials
D 242-70 (R 1980)	Mineral Filler for Bituminous Paving Mixtures
D 1250-80	Petroleum Measurement Tables
D 1856-79	Recovery of Asphalt from Solution by Abson Method
D 2041-78	Theoretical Maximum Specific Gravity of Bituminous Paving Mixtures
D 2042-81	Solubility of Asphalt Materials in Trichloroethylene
D 2172-81	Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
D 2216-80	Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures
D 3381-81	Viscosity-Graded Asphalt Cement for Use in Pavement Construction
D 3515-81	Hot-Mixed, Hot-laid Bituminous Paving Mixtures

2. PLANT, EQUIPMENT, MACHINES, AND TOOLS: The Bituminous plant shall be of such capacity, as specified herinafter, to produce the quantities of bituminous mixtures required for the project. Hauling equipment, paving machines, rollers, miscellaneous equipment, and tools shall be provided in sufficient numbers and capacity and in proper working condition to place the bituminous paving mixtures at a rate equal to the plant putput.

3. MIXING PLANTS: The mixing plant shall be an automatic or semiautomatic controlled, commercially manufactured unit designed and operated to consistently produce a mixture within the job-mix formula (JMF).

The plant shall have a minimum capacity of 250 tons per hour. Drum mixers shall be prequalified at the production rate to be used during actual mix production. The prequalification tests will include extraction and recovery of the asphalt cement in accordance with ASTM D 2172 and ASTM D 1856. The penetration of the recovered asphalt binder shall not be less than 60 percent of the original penetration, as measured in accordance with ASTM D 5.

4. WEATHER LIMITATIONS: Bituminous courses shall be constructed only when the base course or existing pavement has no free water on the surface. Unless otherwise directed, asphalt courses shall not be constructed when the temperature of the surface of the existing pavement or base course is below 40 degrees F.

5. PROTECTION OF PAVEMENT: After final rolling, no vehicular traffic of any kind shall be permitted on the pavement until the pavement has cooled to 140 degrees F.

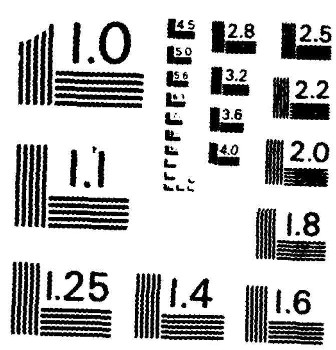
6. GRADE AND SURFACE-SMOOTHNESS REQUIREMENTS: Finished surface of pavements, when tested as specified below and in paragraph ACCEPTABILITY OF WORK, shall conform to elevations shown and to the surface smoothness requirements specified. The grade of the completed surface shall not deviate more than 0.05 foot from the plan grade.

6.1 Plan Grade: Finished surfaces shall conform within tolerances specified to the cross sections indicated. Finished surfaces of airfield and heliport runways, taxiways, and aprons shall vary not more than 0.03 foot from the plan elevation established and approved at site of work, in accordance with the paragraph GRADE CONTROL. Finished surfaces of nonaircraft traffic areas, such as blast pads and stabilized shoulders, shall vary not more than 0.05 foot from plan elevation established and approved at site. Finished surfaces at juncture with other pavements shall coincide with finished surfaces of abutting pavements. The 0.03-foot and 0.05-foot deviations from the plan elevation will not be permitted in areas of pavements where closer conformance with planned elevation is required for the proper functioning of drainage and other appurtenant structures involved. Grade will be determined and evaluated as specified in paragraph ACCEPTABILITY OF WORK.

Dsk RDP 16 (85-1012)

AD-A169 700 ASPHALT-RUBBER SAMI (STRESS-ABSORBING MEMBRANE INTERLAYERS) FIELD EVALUAT..(U) NEW MEXICO ENGINEERING RESEARCH INST ALBUQUERQUE R G MCKEEN ET AL. APR 86 2/2

UNCLASSIFIED NMERI-WA5-7(5.06) AFESC/ESL-TR-86-02 F/G 13/3 NL



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

6.2 Surface Smoothness: Finished surfaces shall not deviate from the testing edge of a 12-foot straightedge more than the tolerances shown for the respective pavement category shown in Table 1. Surface smoothness will be determined and evaluated as specified in paragraph ACCEPTABILITY OF WORK.

6.3 Straightedge: The Contractor shall furnish and maintain at the site, in good condition, one straightedge for each bituminous paver, for use of the Contracting Officer in testing the finished surface. Straightedges shall be constructed of aluminum and shall have blades of box or box-girder cross section with flat bottom reinforced to insure rigidity and accuracy. Straightedges shall have handles to facilitate movement on pavement.

TABLE 1. SURFACE-SMOOTHNESS TOLERANCES

Item No.	Pavement Category	Direction of Testing	Tolerance for Intermediate Course, inch	Tolerance for Wearing Course, inch
1.	Runways and Taxiways	Longitudinal	1/4	1/8
		Transverse	1/4	1/4
2.	Calibration hardstands and compass swinging bases	Longitudinal	1/4	3/16
		Transverse	1/4	3/16
3.	All other airfield and helicopter paved areas	Longitudinal	1/4	1/4
		Transverse	1/4	1/4

7. AGGREGATE SAMPLING AND TESTING

7.1 Aggregates: Samples of aggregates shall be furnished by the Contractor for approval of aggregate sources and stockpiles prior to the start of production and at intervals during production of the bituminous mixtures. Intervals and points of sampling will be designated by the Contracting Officer. Samples will be the basis of approval of specific sources or stockpiles of aggregates for aggregate requirements. Unless otherwise directed, ASTM D 75 shall be used in sampling coarse aggregate and fine aggregate, and ASTM C 183 shall be used in sampling mineral filler

All tests necessary to determine compliance with requirements specified herein will be made by the Government at no expense to the Contractor.

7.2 Sources: Sources of aggregates shall be selected well in advance of the time the materials are required in the work. If a previously developed source is selected, samples shall be submitted 30 calendar days before starting production, with evidence that central-plant, hot-mix bituminous pavements constructed with the aggregates have had a satisfactory service record of at least five years under similar climatic and traffic conditions. Satisfactory service record for an aggregate will be determined based on the aggregate's ability to resist polishing, raveling, stripping, and degradation under traffic and climatic conditions similar to those expected during its use. If performance data indicate that an aggregate is susceptible to one or more of the above-mentioned problems, that source of aggregate shall be rejected. When new sources are developed, the Contractor shall indicate sources and submit samples and his plan for operation 60 calendar days before starting production. The Contracting Officer will make such tests and other investigations as necessary to determine whether aggregates meeting the requirements specified herein can be produced from the proposed sources. Approval of the source of aggregates does not relieve the Contractor of the responsibility for delivery at the jobsite of aggregates that meet the requirements specified herein.

8. ACCEPTABILITY OF WORK:

8.1 General. A lot shall be that quantity of construction that will be evaluated for compliance with specification requirements. A lot shall be equal to 1000 tons or one days production, whichever is less. Testing for acceptability of work will be performed by the Government.

8.1.1 In order to evaluate aggregate gradation, asphalt content, and density, each lot shall be divided into four equal sublots. For density, determination, one random sample shall be taken from the mat, and one ramdom sample shall be taken from the joint of each sublot. Each random sample shall weigh at least 1250 grams. After air drying to a constant weight, random samples obtained from the mat will be used for density determination using MIL-STD-620, Method 101. Samples for determining asphalt content and aggregate gradation shall be taken from loaded trucks within each sublot. Asphalt content will be determined in accordance with ASTM D 2172, Method A or B. Gradation of the aggregate shall be determined from the recovered aggregate according to ASTM C 136.

8.1.2 When a lot of material fails to meet the specification requirements, that lot shall be removed and replaced or accepted at a reduced price. The lowest payment for any pavement characteristic (i.e., gradation, asphalt content, density, grade, and smoothness) discussed below shall be the percent payment for that lot. The percent payment is applied to the bid price to determine actual payment.

8.1.3 The Contracting Officer reserves the right to sample and test any area which appears to deviate from the specification requirements. Testing in these areas will be in addition to the lot testing, and the requirements for these areas will be the same as those for a lot.

8.2 Aggregate Gradation: The mean absolute deviation of the four sublot aggregate gradations from the JMF for each sieve size will be evaluated and compared with Table II. The percent payment based on aggregate gradation shall be the lowest value determined for any sieve size in Table II. All aggregate gradation results will be reported within 24 hours after completion of construction of each lot. The computation of mean absolute deviation for one sieve size is illustrated below:

Example: Assume the following JMF and sublot test results for aggregate gradation.

Sieve Size	JMF	Test No. 1	Test No. 2	Test No. 3	Test No. 4
3/4 in.	100	100	100	100	100
1/2 in.	88	87	88	90	88
3/8 in.	75	72	77	78	74
No. 4	64	60	65	67	62
No. 8	53	50	56	57	52
No. 16	42	39	44	45	41
No. 30	32	30	34	35	32
No. 50	20	17	20	22	21
No. 100	10	8	10	10	11
No 200	6	4	7	8	6

Dsk RDP 16 (85-1012)

$$\text{Mean Absolute Deviation (No. 200 sieve)} = \frac{|4-6| + |7-6| + |8-6| + |6-6|}{4}$$

$$= \frac{2 + 1 + 2 + 0}{4} = 1.25$$

The mean absolute deviation for other sieve sizes can be determined in a similar way for this example to be :

Sieve Size	3/4 Inch	1/2 Inch	3/8 Inch	No. 4	No. 8	No. 16	No. 30	No. 50	No. 100
Mean Absolute Deviation	0	0.75	2.25	2.50	2.75	2.25	1.75	1.50	0.75

The least payment for any sieve size listed in Table II would be 98 percent for the No. 200 sieve. Therefore for this example the percent payment determined for aggregate gradation is 98 percent.

8.3 Asphalt Content : The mean absolute deviation of the four asphalt contents from the JMF will be evaluated and compared with Table III. The percent payment for asphalt content shall be the value determined in accordance with Table III. All asphalt content results will be reported within 24 hours after completion of construction of each lot.

Dsk RDP 16 (85-1012)

TABLE II

PERCENT PAYMENT FOR MEAN ABSOLUTE DEVIATION OF AGGREGATE GRADATIONS FROM JMF

Sieve Size	Percent Payment for Mean Absolute Deviation from JMF 0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0	5.1-6.0	Above 6.0
3/4 In.	100	100	100	100	98	95	90
1/2 In.	100	100	100	100	98	95	90
3/8 In.	100	100	100	100	98	95	90
No. 4	100	100	100	100	98	95	90
No. 8	100	100	100	98	95	90	Reject
No. 16	100	100	100	98	95	90	Reject
No. 30	100	100	100	98	95	90	Reject
No. 50	100	100	100	98	95	90	Reject
No. 100	100	98	95	90	90	Reject	Reject
No. 200	100	98	90	Reject	Reject	Reject	Reject

TABLE III

PERCENT PAYMENT FOR ASPHALT

Mean Absolute Deviation of Extracted Asphalt Content from JMF	Percent Payment
Less than 0.20	100
0.21 - 0.30	98
0.31 - 0.35	95
0.36 - 0.40	90
Above 0.40	Reject

Dsk RDP 16 (85-1012)

8.4 Density: The average mat density and the average joint density will be expressed as a percentage of the laboratory density. The laboratory density for each lot will be determined from four sets of laboratory samples. One sample will be obtained from each of the four sublots. Laboratory samples will be prepared from asphalt mixture which has not been reheated in the laboratory. Samples will be compacted in accordance with MIL-STD-620 within 2 hours of the time the mixture was loaded into trucks at the asphalt plant.

8.4.1 The field density will be determined and compared with Table IV. The percent payment for density shall be the lowest value determined from Table IV. The percent payment for mat density represents all of the material placed in the lot. The percent payment for joint density is based on the amount of material represented by an area equal to the lot joint length by 10 feet wide not to exceed the lot size.

8.4.2 All density results on a lot will be completed and reported within 24 hours after construction of that lot. When the Contracting Officer considers it necessary to take additional samples for density measurements, sampling will be done in groups of four (one for each sublot). The percent payment shall be determined for each additional group of four samples and averaged with the percent payment for the original group to determine the final percent payment. The Contractor shall fill all sample holes with hot mix and compact.

8.5 Grade: The finished surface of the pavement will be tested for conformance with specified plan-grade requirements. The finished grade of each pavement area will be determined by running lines of levels at intervals of 25 feet or less longitudinally and transversely to determine the elevation of the completed pavement. Within 5 working days after completion of a particular lot, the Contracting Officer will inform the Contractor in writing of results of grade-conformance tests. When more than 5 percent of all measurements made within a lot are outside the specified tolerances, the payment for that lot will not exceed 95 percent of the bid price. In areas where the grade exceeds the plan-grade tolerances given in paragraph GRADE AND SURFACE-SMOOTHNESS REQUIREMENTS by more than 50 percent, the Contracting Officer shall require removal and replacement of the deficient area at no additional cost to the Government. Sufficient material shall be removed to allow at least 1 inch of asphalt concrete to be placed. Skin patching for correcting low areas or planing for correcting high areas shall not be permitted on the wearing course.

TABLE IV

PERCENT PAYMENT FOR DENSITY

Ave. Mat Density (4 Cores)	Percent Payment	Ave. Joint Density (4 Cores)
98.0, 100.0	100	Above 96.5
97.9	100	96.4
97.8, 100.1	99.9	96.3
97.7	99.8	96.2
97.6, 100.2	99.6	96.1
97.5	99.4	96
97.4, 100.3	99.1	95.9
97.3	98.7	95.8
97.2, 100.4	98.3	95.7
97.1	97.8	95.6
97.0, 100.5	97.3	95.5
96.9	96.3	95.4
96.8, 100.6	94.1	95.3
96.7	92.2	95.2
96.6, 100.7	90.3	95.1
96.5	87.9	95
96.4, 100.8	85.7	94.9
96.3	83.3	94.8
96.2, 100.9	80.6	94.7
96.1	78	94.6
96.0, 101.0	75	94.5
Below 96.0	Reject	Below 94.5
Above 101.0	Reject	

Dsk RDP 16 (85-1012)

8.6 Surface Smoothness: After the completion of final rolling of a lot, the compacted surface will be tested by the Contracting Officer with a 12-foot straightedge. Measurements will be made perpendicular to and across all joints at equal distances along the joint not to exceed 25 feet. Location and deviation from straightedge for all measurements will be recorded. When more than 5 percent of all measurements along the joints within the lot exceed the specified tolerance, the unit price for that lot shall not exceed 95 percent of the bid price. Any joint or mat area surface deviation which exceeds the tolerance given in Table I by more than 50 percent shall be corrected to meet the specification requirements.

9. ACCESS TO PLANT AND EQUIPMENT: The Contracting Officer shall have access at all times to all parts of the paving plant for checking adequacy of equipment in use; inspecting operation of the plant; verifying weights, proportions, and character of materials; and checking temperatures maintained in preparation of mixtures.

10. WAYBILLS AND DELIVERY TICKETS: Waybills and delivery tickets shall be submitted to the Contracting Officer during progress of the work. Before the final statement is allowed, the Contractor shall file with the Contracting Officer certified waybills and certified delivery tickets for all aggregates and bituminous materials actually used in the construction and covered by the contract.

11. MEASUREMENT.

11.1 Intermediate and Wearing-Course Tonnage: The amount paid for will be the number of 2,000-pound tons of bituminous mixture used in the accepted work. Bituminous mixture shall be weighed after mixing, and no deduction will be made for weight of bituminous materials incorporated herein.

11.2 Correction Factor for Aggregate Used. Quantities of paving mixtures called for are based on aggregates having a specific gravity of 2.70 as determined in accordance with the Apparent Specific Gravity paragraphs in ASTM C 127 and ASTM C 128. Correction in tonnage of intermediate and wearing-course mixtures shall be made to compensate for the difference in tonnage of mixtures used in the project, when specific gravities of aggregates used in mixtures are more than 2.75 and less than 2.65. Tonnage paid for will be the number of tons used, proportionately corrected for specific gravities, using 2.70 as the base correctional factor.

11.3 Bituminous Material : Bituminous material to be paid for shall be the number of 2,000-pound tons of material used in the accepted work.

12. PAYMENT : Quantities of intermediate and wearing-course mixtures and bituminous materials, determined as specified above, will be paid for at respective contract unit prices or at specified reduced prices. Payment shall constitute full compensation for preparing or reconditioning the base course or existing pavement; for furnishing all materials, equipment, plant, and tools: and for all labor and other incidentals necessary to complete the work required by this section of the specifications.

PART 2 - PRODUCTS

13. BITUMINOUS HOT MIX shall consist of coarse aggregate, fine aggregate, mineral filler, bituminous material, and approved additives, if required, of the quqlities and in the proportions specified.

14. PROPERTIES OF AGGREGATES, BITUMINOUS MATERIALS, AND BITUMINOUS MIXTURES:

14.1 Aggregates : Aggregates shall consist of natural sand, crushed stone, crushed gravel, crushed slag, screenings, sand, and mineral filler, as required. The portion of materials retained on the No. 4 sieve shall be known as coarse aggregate; the portion passing the No. 4 sieve and retained on the No. 200 sieve as fine aggregate; and the portion passing the No. 200 sieve as mineral filler. Aggregate gradation shall conform to gradation(s) specified in Table V. Table V is based on aggregates of uniform specific gravity; the percentage passing various sieves may be changed by the Contracting Officer when aggregates of varying specific gravities are used. Adjustments of percentages passing various sieves may be directed by the Contracting Officer when aggregates vary by more than 0.2 in specific gravity

TABLE V. AGGREGATE GRADATION

Sieve	Percent Passing
3/4 in.	100
1/2 in	82 ± 10
3/8 in	74 ± 10
No. 4	56 ± 10
No. 8	41 ± 10
No 50	6 ± 7
No. 200	7.5 ± 3

14.1.1 Coarse aggregate shall consist of clean, sound, durable particles meeting the following requirements.

14.1.1.1 Percentage of loss shall not exceed 40 after 500 revolutions, as determined in accordance with ASTM C 131.

14.1.1.2 Percentage of loss shall not exceed 15 after five cycles performed in accordance with ASTM C 88 using magnesium sulfate.

14.1.1.3 The dry weight of crushed slag shall not be less than 75 pcf, as determined in accordance with ASTM C 29.

14.1.1.4 Crushed gravel retained on the No. 4 sieve and each coarser sieve listed in Table V shall contain at least 75 percent by weight of crushed pieces having two or more fractured faces with the area of each face equal to at least 75 percent of the smallest midsectional area of the piece. When two fractures are contiguous, the angle between planes of fractures shall be at least 30 degrees to count as two fractured faces.

14.1.1.5 Particle shape of crushed aggregates shall be essentially cubical. Quantity of flat and elongated particles in any sieve size shall not exceed 20 percent by weight, when determined in accordance with CRD-C 119.

14.1.2 Fine aggregate shall consist of clean, sound, durable, angular particles produced by crushing stone, slag, or gravel that meets requirements for wear and soundness specified for coarse aggregate. Fine aggregate produced by crushing gravel shall have at least 90 percent by weight of

Dsk RDP 16 (85-1012)

crushed particles having two or more fractured faces in the portion retained on the No. 30 sieve. This requirement shall apply to material before blending with natural sand, when blending is necessary. Quantity of natural sand to be added to the wearing or intermediate-course mixtures shall not exceed 15 percent by weight of coarse and fine aggregate and material passing the No. 200 sieve. Natural sand shall be clean and free from clay and organic matter. Percentage of loss shall not exceed 15 after five cycles of the soundness test performed in accordance with ASTM C 88 using magnesium sulfate.

14.1.3 Mineral filler shall conform to ASTM D 242 except the following gradations will be included:

Grain Size in mm	Percent finer
0.05	70-100
0.02	35-65
0.005	10-22

14.1.4 Sampling and Testing: Sampling and testing shall be the responsibility of the Contractor. Sampling and testing shall be performed by an approved independent commercial testing laboratory with results certified by a registered professional engineer. Certification based on past performance of the aggregates and testing can be used with the approval of the Contracting Officer. Approval must be obtained 30 calendar days prior to use of the aggregates.

14.2 Bituminous Materials: Samples of bituminous materials shall be obtained by the Contractor; sampling shall be in accordance with ASTM D 140. Tests necessary to determine conformance with requirements specified herein will be performed by the Contracting Officer without cost to the Contractor. Sources where bituminous materials are obtained shall be selected in advance of time when materials will be required in the work, and samples of the asphalt cement specified shall be submitted for approval not less than seven days before production of the asphalt mixture

14.2.1 Asphalt cement shall conform to ASTM D 3381 Table 1, Grade AC-20.

14.2.2 In addition to initial qualification testing of bituminous materials, samples shall be taken before and during construction when shipments of bituminous materials are received or when necessary to assure that handling or storage has not been detrimental to the bituminous material. The samples shall be taken by the Contractor and tested by the Contracting Officer.

14.3 Bituminous Mixtures. Sampling and testing will be accomplished by the Contracting Officer. Bituminous mixtures shall conform to requirements contained in paragraphs PROPORTIONING OF MIXTURE and ACCEPTABILITY OF WORK.

14.4 Additives: The use of additives such as antistripping and antifoaming agents is subject to approval by the Contracting Officer.

15 DELIVERY, STORAGE, AND HANDLING OF MATERIALS

15.1 Mineral Aggregates: Mineral aggregates shall be delivered to the site of the bituminous mixing plant and stockpiled in such a manner as to preclude fracturing of the aggregate particles, segregation, contamination, or intermingling of different materials in the stockpiles or cold-feed hoppers. Mineral filler shall be delivered, stored, and introduced into the mixing plant in a manner to preclude exposure to moisture or other detrimental conditions.

15.2 Bituminous Materials: Bituminous materials shall be maintained at appropriate temperature during storage but shall not be heated by application of direct flame to walls of storage tanks or transfer lines. Storage tanks, transfer lines, and weigh bucket shall be thoroughly cleaned before a different type or grade of bitumen is introduced into the system. The asphalt cement shall be heated sufficiently to allow satisfactory pumping of the material; however, the storage temperature shall be maintained below 300 degrees F.

16 PROPORTIONING OF MIXTURE

16.1 Job Mix Formula. The mixture design and job mix formula will be developed by the Contractor at no additional expense to the Government. The mixture design shall be prepared under the direct supervision of a registered professional engineer experienced in the development of mixture designs and mixture design testing. Procedures for the mixture design will be in accordance with MIL-STD-620 and to the criteria described in paragraphs 14 and 16. The proposed mixture design and job mix formula will be submitted

to the Contracting Officer for approval 21 days prior to beginning production of bituminous mixture for this project. No payment will be made for mixture produced prior to the approval of the mixture design and job mix formula. The formula will indicate the percentage of each stockpile and mineral filler, the percentage passing each sieve size, the percentage of bitumen, and the temperature of the completed mixture when discharged from the mixer. The proposed mixture design will also include source of bituminous material and source of aggregates along with certification that aggregates meet the requirements of paragraph 14. Tolerances are given in Table VI for asphalt content, temperature, and aggregate grading for tests conducted on the mix as discharged from the mixing plant; however, the final evaluation of aggregate gradation and asphalt content will be based on paragraph ACCEPTABILITY OF WORK. Bituminous mixture that deviates more than 25 degrees from JMF shall be rejected. The JMF may be adjusted during construction to improve paving mixtures, as directed, without adjustments in the contract unit price.

TABLE VI. JOB-MIX TOLERANCES

Material	Tolerance, Plus or Minus
Aggregate passing No. 4 or larger sieves	4 percent
Aggregate passing Nos. 8, 16, 30, and 50 sieves	3 percent
Aggregate passing Nos. 100 and 200 sieves	1.0 percent
Bitumen	0.20 percent
Temperature of mixing	25 degrees F

16.2 Test Properties of Bituminous Mixtures : Finished mixture shall meet requirements described below when tested in accordance with MIL-STD-620 (75 blow, Marshall Method). All samples will be compacted with 75 blows of specified hammer on each side of sample. When bituminous mixture fails to meet the requirements specified below, the paving operation shall be stopped until the cause of noncompliance is determined and corrected.

16.2.1 Requirements for stability, flow, and voids are shown in Tables VII and VIII for nonabsorptive and absorptive aggregates, respectively.

TABLE VII. NONABSORPTIVE-AGGREGATE MIXTURE

Stability minimum, pounds	1800
Flow maximum, 1/100 inch units	16
Voids total mix, percent (1)	3-5
Voids filled with bitumen, percent	70-80

(1) The Contracting Officer may permit deviations from limits specified when gyratory method of design is used to develop JMF.

TABLE VIII. ABSORPTIVE-AGGREGATE MIXTURE

Stability minimum, pounds	1800
Flow maximum, 1/100 inch units	16
Voids total mix, percent (1)	2-4
Voids filled with bitumen, percent	75-85

(1) The Contracting Officer may permit deviations from limits specified when gyratory method of design is used to develop JMF

16.2.1.1 When the water-absorption value of the entire blend of aggregate does not exceed 2.5 percent, as determined in accordance with ASTM C 127 and C 128, the aggregate is designated as nonabsorptive. The theoretical specific gravity computed from the apparent specific gravity or ASTM D 2041 will be used in computing voids total mix and voids filled with bitumen, and the mixture shall meet the requirements in Table VII

16.2.1.2 When the water-absorption value of the entire blend of aggregate exceeds 2.5 percent as determined in accordance with ASTM C 127 and ASTM C 128, the aggregate is designated as absorptive. The theoretical specific gravity computed from the bulk-impregnated specific gravity method contained in MIL-STD-620, Method 105 or ASTM D 2041 shall be used in computing percentages of voids total mix and voids filled with bitumen; the mixture shall meet requirements in Table VIII, when MIL-STD-620, Method 105 is used and Table VII when ASTM D 2041 is used.

16.2.2 The index of retained stability must be greater than 75 percent as determined by MIL-STD-620, Method 104. When the index of retained stability is less than 75, the aggregate stripping tendencies may be countered by the use of hydrated lime or by treating the bitumen with an approved antistripping agent. The hydrated lime is considered as mineral filler and should be considered in the gradation requirements. The amount of hydrated lime or antistripping agent added to bitumen shall be sufficient, as approved by the Contracting Officer, to produce an index of retained stability of not less than 75 percent. No additional payment will be made to the Contractor for addtion of antistripping agent or hydrated lime required.

PART 3 - EXECUTION

17. CONDITIONING OF BASE COURSE OR EXISTING PAVEMENT: Previously constructed base course or existing pavement shall be conditioned as specified below. In all cases, prior to the laying of bituminous course, the surface shall be prepared as directed that will include a tack coat for asphalt concrete and sawed asphalt concrete test sections.

17.1 Treatment of Existing Pavements That Will Serve as Base for Overlay or Other Treatments.

17.1.1 Seal all cracks that are wider than 1/8 inch

17.1.1.1. Joints and cracks that are greater than 1/8 inch and less than 1/4 inch in opening width shall be cleaned by compressed air. This cleaning shall remove all loose material such as old sealant and debris that has accumulated as a result of service or removal of existing overlay(s). These cracks shall be filled with a sealant approved by the Contracting Officer. Sealant shall be allowed sufficient time to cure prior to placement of any overlay material including fabric, stress absorbing membrane interlayer, or conventional asphalt concrete overlay.

Dsk RDP 16 (85-1012)

17.1.1.2 Joints and cracks that are wider than 1/4 inch shall be cleaned by a combination of mechanical routing, wire brushing, or high-pressure water blasting and compressed air to remove all old sealant, and other materials such as old paving components and debris. All joints and cracks will be allowed to come to complete dryness before any subsequent applications of sealant, overlay, or other following work. Joints and cracks that are wider than 1/4 inch and less than 1/2 inch shall be filled to within 1/2 inch of the surface at the time of sealing with a sealant material approved by the Contracting Officer. Joints and cracks with openings greater than 1/2 inch shall be filled to within 1/2 inch of the surface at the time of sealing with a sealant consisting of 80 percent by weight of mixture of fine sand and 20 percent slow cure emulsified asphalt that is hand rammed and compacted into the joint or crack.

18. GRADE CONTROL : Lines and grades shown on contract drawings for each pavement category of contract shall be established and maintained by means of line and grade stakes placed at the site of work by the Contractor. Elevations of bench marks used by the Contractor for controlling airfield and heliport pavement operations at the site of work will be determined, established, and maintained by the Government. Finished pavement elevations shown shall be established and controlled at the site of work by the Contractor in accordance with bench mark elevations furnished by the Contracting Officer.

19 PREPARATION OF MINERAL AGGREGATES : Each aggregate stockpile shall be placed and maintained in such a manner to prevent segregation. Rates of feed of aggregates shall be regulated so that moisture content and temperature of aggregates will be within tolerances specified herein. Dry storage shall be provided for mineral filler.

20 PREPARATION OF BITUMINOUS MIXTURES : Aggregates, mineral filler, and bitumen shall be conveyed into the mixer in proportionate quantities required to meet the JMF. Mixing time shall be as required to obtain a uniform coating of the aggregate with the bituminous material. Temperatures of bitumen at the time of mixing shall not exceed 300 degrees F. Temperature of aggregate and mineral filler in the mixer shall not exceed 325 degrees F when the bitumen is added. Overheated and carbonized mixtures or mixtures that foam will be rejected.

21. WATER CONTENT OF AGGREGATES: Drying operations shall reduce the water content of mixture to less than 0.75 percent. Water content test will be conducted in accordance with ASTM D 2216: weight of sample shall be at least 500 grams. If water content is determined on hot bin samples, the water content will be a weighted average based on the composition of the blend.

22. STORAGE OF BITUMINOUS PAVING MIXTURE. Storage of bituminous paving mixture shall conform to the applicable requirements of ASTM D 3515; however, in no case shall the mixture be stored for more than 4 hours.

23. TRANSPORTATION OF BITUMINOUS MIXTURE: Transportation from the production plant to the site shall be in trucks having tight, clean, smooth beds lightly coated with an approved relasing agent to prevent adhesion of mixture to truck bodies. Excessive releasing agent shall be drained prior to loading. Each load shall be covered with canvas or other approved material of ample size to protect mixture from weather and prevent loss of heat if directed by the Contracting Officer. Loads that have crusts of cold, unworkable material or have become wet by rain will be rejected. Hauling over freshly placed material will not be permitted.

24. PLACING: Bituminous mixtures shall not be placed without ample time to complete spreading and rolling during daylight hours, unless approved satisfactory lighting is provided.

24.1. Surface Preparation of Underlying Course. Prior to the placing of intermediate or wearing course, the underlying course shall be cleaned of all foreign or objectionable matter with power brooms and hand brooms.

24.2. Spraying Contact Surfaces of Structures. Contact surfaces of previously constructed pavement, curbs, manholes, and similar structures shall be sprayed with a thin coat of bituminous material conforming to the requirements of TACK COAT.

24.3. Offsetting Joints in Intermediate and Wearing Courses. The wearing course shall be placed so that the longitudinal joints of the wearing course will be offset from joints in the intermediate course by at least 1 foot. Transverse joints in the wearing course shall be offset by at least 2 feet from the transverse joints in the intermediate course.

Dsk RDP 16 (85-1012)

24.4. General Requirements for Use of Mechanical Spreader: The range of temperatures of mixtures, when dumped into the mechanical spreader, shall be as determined by the Contracting Officer. Unless otherwise specified, mixtures having temperatures less than 225 degrees F. when dumped into the mechanical spreader will be rejected. The mechanical spreader shall be adjusted and the speed regulated so that the surface of the course being laid will be smooth and continuous without tears and pulls, and of such depth that, when compacted, the surface will conform to the cross section indicated. Placing with respect to centerline areas with crowned sections or high sides of areas with one-way slope shall be as directed. Each lot of material placed shall conform to requirements specified in paragraph ACCEPTABILITY OF WORK. Placing of the mixture shall be as nearly continuous as possible, and the speed of placing shall be adjusted, as directed, to permit proper rolling. When segregation occurs in the mixture during placing, the spreading operation shall be suspended until the cause is determined and corrected.

24.5. Placing Strips Succeeding Initial Strips: In placing each succeeding strip after the initial strip has been spread and compacted as specified below, the screed of the mechanical spreader shall overlap the previously placed strip 2 to 3 inches and be sufficiently high so that compaction produces a smooth dense joint. Mixture placed on the edge of a previously placed strip by the mechanical spreader shall be pushed back to the edge of the strip by the use of a lute. Excess material shall be removed and wasted.

24.6 Handspreading in Lieu of Machine Spreading. In areas where use of machine spreading is impractical, the mixture shall be spread by hand. Spreading shall be in a manner to prevent segregation. The mixture shall be spread uniformly with hot rakes in a loose layer of thickness, that when compacted, will conform to the required grade, density, and thickness.

25. COMPACTION OF MIXTURE. Sufficient rollers (size, type, and number) shall be furnished to obtain the specified compaction. Rolling shall begin as soon after placing as the mixture will bear a roller without undue displacement. Delays in rolling freshly spread mixture will not be permitted. After initial rolling, preliminary tests of crown, grade, and smoothness shall be made by the Contractor. Deficiencies shall be corrected so that the finished course will conform to requirements for grade and smoothness specified herein. Crown, grade, and smoothness will be checked for compliance in each lot of completed pavement by the Contracting Officer and will be evaluated as specified in paragraph ACCEPTABILITY OF WORK.

After the crown, grade, and smoothness requirements have been met, rolling shall be continued until a mat density of 98.0 to 100.0 percent and a joint density of 96.5 to 100.0 percent of density of laboratory-compacted specimens of the same mixture are obtained. The density will be determined and evaluated as specified in paragraph ACCEPTABILITY OF WORK. Places inaccessible to rollers shall be thoroughly compacted with hot hand tampers

25.1 Testing of Mixture : At the start of plant operation, a quantity of mixture shall be prepared sufficiently to construct a test section at least 50 feet long and two spreader widths wide. Mixture shall be placed, spread, and rolled with the equipment to be used in the project and in accordance with requirements specified above. This test section shall be tested and evaluated as a lot and shall conform to all specified requirements. If test results are satisfactory, the test section shall remain in place as part of the completed pavement. If tests indicate that the pavement does not conform to specification requirements, necessary adjustments to the plant operations and rolling procedures shall be made immediately. Additional test sections, as directed, shall be constructed and sampled for conformance with specification requirements. In no case shall the Contractor start full production of an intermediate or wearing course mixture without approval

25.2 Correcting Deficient Areas : Mixtures that become contaminated or are defective shall be removed to the full thickness of the course. Edges of the area to be removed shall be cut so that the sides are perpendicular and parallel to the direction of traffic and so that the edges are vertical. Edges shall be sprayed with bituminous materials conforming to BITUMINOUS TACK COAT. Fresh paving mixture shall be placed in the excavated areas in sufficient quantity so that the finished surface will conform to the grade and smoothness requirements. Paving mixture shall be compacted to the density specified herein. Skin patching of an area that has been rolled shall not be permitted.

26 JOINTS

26.1 General Joints between old and new pavements, or between successive days' work, or joints that have become cold (less than 175 degrees F.) because of any delay shall be made to insure continuous bond between the old and new sections of the course. All joints shall have the same texture and smoothness as other sections of the course. Contact surfaces of previously constructed pavements coated by dust, sand, or other objectionable material shall be cleaned by brushing or shall be cut back as directed. When directed

by the Contracting Officer, the surface against which new material is placed shall be sprayed with a thin, uniform coat of bituminous material conforming to BITUMINOUS TACK COAT. Material shall be applied far enough in advance of the placement of fresh mixture to insure adequate curing. Care shall be taken to prevent damage or contamination of the sprayed surface.

26.2 Transverse Joints: The roller shall pass over the unprotected end of a strip of freshly placed material only when the placing is discontinued or the delivery of the mixture is interrupted to the extent that material in place may become cold. In all cases, prior to continuing placement, the edge of previously placed pavement shall be cut back to expose an even vertical surface for full thickness of the course. In continuing placement of the strip, the mechanical spreader shall be positioned on the transverse joint so that sufficient hot mixture will be spread to obtain a joint after rolling that conforms to the required density and smoothness specified herein.

26.3 Longitudinal Joints: Edges of a previously placed strip shall be prepared such that the pavement in and immediately adjacent to the joint between this strip and the succeeding strip meets the requirements for grade, smoothness, and density as described in paragraph ACCEPTABILITY OF WORK.

Dsk RDP 16 (85-1012)

SECTION D-2

ASPHALT - RUBBER SURFACE TREATMENT OR INTERLAYER *

1. APPLICABLE PUBLICATIONS
2. DESCRIPTION
3. MATERIALS
   - 3.1 ASPHALT
   - 3.2 RUBBER EXTENDER OIL
   - 3.3 KEROSENE
   - 3.4 GROUND RUBBER COMPONENTS
   - 3.5 AGGREGATES
   - 3.6 TACK COATS
   - 3.7 CERTIFICATION AND QUALITY ASSURANCE
4. EQUIPMENT
5. CONSTRUCTION DETAILS
6. METHOD OF MEASUREMENT
7. BASIS OF PAYMENT

1. APPLICABLE PUBLICATIONS : The Publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

1.1 American Society for Testing and Materials (ASTM) Publications :

D 88-81	Saybolt Viscosity
D 92-78	Flash and Fire Points By Cleveland Open Cup
D2007-75	Test Method for Characteristic Groups in Rubber Extender and Processing Oils by the Clay-Gel Adsorption Chromatographic Method
D 850-79	Methods for Distillation of Industrial Aromatic Hydrocarbons and Related Materials
D 297-81	Methods for Rubber Products - Chemical Analysis

*For surface preparation, see Section D-1, paragraph 17.

Dsk RDP 16 (85-1013)

C 136-83	Sieve Analysis of Fine and Coarse Aggregates
D 448-80	Standard Sizes of Coarse Aggregate for Highway Construction
D 2994-71	Rubberized Tar
C 566 -78	Total Moisture Content of Aggregate by Drying

1.2 American Association of State Highway and Transportation Officials (AASHTO):

M 283-81	Coarse Aggregate for Highway & Airport Construction
T 202-80	Viscosity of Asphalts by Vacuum Capillary Viscometer
M 20-70	Penetration Graded Asphalt Cement
M 226-80	Viscosity Graded Asphalt Cement

2. DESCRIPTION: This work involves placement of an asphalt-rubber treatment on a prepared pavement surface in accordance with the plans and specifications.

2.1 This specification describes two known proprietary processes for production of the treatment hereinafter known as Method A and Method B. Method A uses ground vulcanized rubber and an extender oil whereas Method B uses ground vulcanized rubber and a kerosene diluent. Either method is acceptable based on proper compliance with the specifications and certification of materials.

3. MATERIALS:

3.1 Asphalt Cement: Asphalt cement shall meet the requirements of AASHTO M 20 (Table 1) or M 226 (Table 1 or 3). Acceptable grades for the respective materials will depend on location and circumstances and will require approval of the Supplier of the Asphalt-Rubber. In addition, it shall be fully compatible with the ground rubber proposed for the work as determined by the Supplier.

Dsk RDP 16 (85-1013)

3.2 Rubber Extender Oil (Method A): Extender oil shall be a resinous, high flash point aromatic hydrocarbon meeting the following test requirements:

Viscosity, SSU, at 100 degrees F. (ASTM D 88)	2500 min.
Flash Point, COC, degrees F. (ASTM D 92)	390 min.
Molecular Analysis (ASTM D 2007):	
Asphaltenes, Wt. %	0.1 max.
Aromatics, Wt. %	55.0 mim.

ARCO METHOD

3.3 Kerosene Type Diluent (Method B): The kerosene type diluent used shall be compatible with all materials used and shall have a flash point (ASTM D 92) of not less than 80 degrees F. The initial boiling point shall not be less than 300 degrees F with the total distillaion (dry point) before 450 degrees F (ASTM D 850). The Contractor is cautioned that a normal kerosene or range oil cut may not be suitable.

SAHUARO METHOD

3.4 Ground Rubber Components:

3.4.1 For Method A: The rubber shall be a ground tire rubber, recommended by the Supplier for this use and with the approval of the Contracting Officer. The rubber shall meet the following physical and chemical requirements:

3.4.1.1 Two types of rubber shall be blended. Rubber types 1 and 2 shall meet the requirements of Table I with the tests as described by ASTM D 297. The rubbers shall be blended such that the resulting material conforms to the requirements of Table I.

TABLE I. RUBBER REQUIREMENTS

Property	TYPE 1 Min.	TYPE 1 Max.	TYPE 2 Min.	TYPE 2 Max.	BLEND Min.	BLEND Max.
Specific Gravity	1.15	1.17	1.12	1.14	1.14	1.16
Total Extract (%)	14	21	8	12	12	15
Ash (Wt.%)	3.0	6.0	3.8	4.2	4.5	5.5
Free Carbon (Wt. %)	28	32	27	29	27.5	29.5
Total Sulfur (Wt. %)	1.0	1.2	1.0	1.2	1.0	1.2
Rubber Polymer:						
Natural Rubber (Wt. %)	18	32	85	95	50	60
Styrene Butadiene (Wt. %)	58	82	85	95	35	45
Polybutadiene (Wt. %)	0	12	0	0	4	8
Rubber Hydrocarbon (Wt. %)	50	65	50	60	55	65

3.4.1.2. The rubber blend shall be dry and free flowing, free of wire, fabric, or other contaminants, except up to 4 weight percent of mineral powder may be included to prevent sticking of particles. Rubber constituents and moisture content shall be such that when mixed with asphalt, foaming of the blend does not occur.

Dsk RDP 16 (85-1013)

3.4.1.3 Sieve Analysis (ASTM C 136):

Sieve	Percent Passing
No. 8	100
No. 30	30-50
No. 50	5-30
No. 100	0-5

3.4.2 For Method B: The rubber shall be a ground tire rubber, 100 percent vulcanized, recommended by the Supplier for this use and with the approval of the Contract.n.g Officer.

3.4.2.1 Composition: The rubber shall comply with the requirements for Type 1 rubber described in Table 1.

3.4.2.2 The rubber shall be dry and free flowing, free from wire, fabric, or other contaminants except up to 4 weight percent of a mineral powder may be included to prevent sticking of the particles. Rubber constituents and moisture content shall be such that when mixed with asphalt, foaming of the blend will not occur.

3.4.2.3 Sieve Analysis (ASTM C 136)

Sieve	Percent Passing
No. 8	100
No. 10	98-100
No. 30	0-10
No 50	0-2

3.5 Aggregates: Cover aggregates shall be a dry, clean material meeting the requirements of AASHTO M 283 and the additional requirements listed below:

3.5.1 Only crushed stone or slag will be acceptable. Hot or precoated aggregates, if used, will be by special provisions in the documents.

3.5.2 The aggregate shall not contain more than 5 weight percent chert or other known stripping material.

3.5.3 Gradation shall be according to ASTM D 448, Size 7 with the addition that not more than 1 weight percent shall pass the No 50 sieve

Dsk RDP 16 (85-1013)

3.5.4 The aggregate shall be essentially free of deleterious material such as thin elongated pieces, dirt, dust, and shall contain not more than 1 weight percent water (ASTM C566).

3.6 Tack Coat (Methods A and B): The tack coat shall be applied as shown on the plans, in the specifications, or as directed by the Contracting Officer. Application shall be according to materials and methods specified in TACK COATS.

3.7 Certifications and Submittals: Prior to application, the Contractor shall submit certification of specification compliance for all materials to be used in the work. The Contracting Officer reserves the right to sample and test any materials used in the work. Certification shall be submitted concerning the design of the asphalt-rubber blend as follows:

3.7.1 Method A. The Contractor shall submit certification that the asphalt cement is compatible with the rubber and has been tested to determine the quantity of extender oil (usually 1 to 7 weight percent) required and that the proposed percentage will produce an absolute viscosity of the blended materials of 600 to 2,000 poises at 140 degrees F when tested in accordance with the requirements of AASHTO T 202. New certifications will be required if the asphalt cement lot or source of rubber is changed.

3.7.2 Method B. The Contractor shall submit certifications that the asphalt cement is compatible with the rubber. New certifications will be required if the asphalt cement lot or rubber source is changed.

3.7.3 For either method, the Contractor shall submit information (that will vary with location) that shows, to the satisfaction of the Contracting Officer, that the asphalt-rubber and aggregate combination proposed for the project will not be subject to water stripping in the environmental exposure of the project.

4. EQUIPMENT

4.1 Preblending: Rubber and a portion of the asphalt for the asphalt-rubber blend shall be preblended in a master batch prior to introduction of the master batch to the distributor. The master batch can be diluted with additional asphalt and additives in the distributor to the formulation recommended by the Supplier

Dsk RDP 16 (85-1013)

4.2 Distributor : At least one pressure type bituminous distributor in good condition will be required. The distributor shall be equipped so as to be capable of even heating of the material up to 425 degrees F, have adequate pump capacity to maintain a high rate of circulation in the tank; have adequate pressure devices and suitable manifolds to provide constant positive cut-off to prevent dripping from the nozzles. The distributor bar shall be fully circulating with nipples and valves so constructed that they are in such intimate contact with the circulating asphalt that the nipples will not become partially plugged with congealing asphalt upon standing, thereby causing streaked or irregulat distribution of the asphalt-rubber.

4.2.1 Any distributor that produces a streaked or irregular distribution of the material shall be promptly removed from the project. Distributor equipment shall include a tachometer, pressure gages, volume measuring devices, and a thermometer for reading temperature of tank contents. The asphalt-rubber sections shall be so constructed that uniform applications may be made at the specified rate per square yard within a tolerance of plus or minus 0.03 gallons per square yard. It is suggested that the distributors used for Method B be equipped with mechanical mixing devices.

4.3 Chip Spreader : A self propelled chip spreader in good condition and of sufficient capacity to apply the aggregate within the time period specified will be required. The spreader shall be so constructed that it can be accurately gauged and set to uniformly distribute the required amount of aggregate at regulated speed.

4.4 Brooms : Revolving and drag brooms shall be so constructed as to sweep clean or redistribute aggregate without damage to the surface.

4.5 Power Rollers : There shall be at least one self-propelled steel wheel roller rated at 5 t0 8 tons capacity for each mile or fraction thereof of 12-foot wide surfacing or interlayer applied per day. The rollers shall have a weight of not less than 200 pounds to the lineal inch of drum.

4.6 Pneumatic Tire Rollers : There shall be at least three multiple wheel pneumatic self-propelled rollers with provisions for loading to at least 8 tons and at a tire inflation pressure as required by the Contracting Officer with a minimum 3,000 pounds per wheel.

4.7 Trucks : Trucks of sufficient number and size to adequately supply the material will be required. Trucks shall be properly equipped for use with the chip spreader.

Dsk RDP 16 (85-1013)

4.8 Municipal Type Street Sweeper : If the Contractor intends to put traffic on the asphalt-rubber surface treatment or interlayer, it may be necessary to sweep the surface with a Municipal Type Street Sweeper to pick up and remove stone and dust lodged in the surface prior to further applications of paving materials onto the asphalt-rubber.

5. CONSTRUCTION DETAILS :

5.1 Preparation of Binder, Method A :

5.1.1 Preparation of Asphalt-Extender Oil Mix Blend : Blend the preheated asphalt cement (250 to 400 degrees F), and sufficient rubber extender oil (1 to 7 weight percent) to reduce the viscosity of the asphalt cement-extender oil blend to within the specified viscosity range. Mixing shall be thorough by recirculation, mechanical stirring, air agitation, or other appropriate means. A minimum of 400 gallons of the asohalt cement-extender oil blend shall be prepared before introduction of the rubber.

5.1.2 Preparation of Asphalt-Rubber Binder : The asphalt-extender oil blend shall be heated to within the range of 350 to 425 degrees F. The asphalt-rubber blend for the master batch shall be preblended in appropriate preblending equipment, as specified by the Supplier, prior to introduction of the master batch into the distributor. Addition of asphalt cement into the distributor to provide the specified formula shall be as directed by the Supplier. The percentage of rubber shall be 20 to 24 weight percent of the total blend as specified by the Supplier. Recirculation shall continue for a minimum of 30 minutes after all the rubber is incorporated to insure proper mixing and dispersion. Sufficient heat shall be applied to maintain the temperature of the blend between 375 and 425 degrees F while mixing. Viscosity of the asphalt-rubber shall be less than 4,000 centipoises at the time of application (ASTM D 2994 with the use of a Haake type viscometer allowed in lieu of a Brookfield Model LVF or LVT if desired).

5.2 Preparation of Binder, Method B .

5.2.1 Preparation of the Asphalt-Rubber Blend - Mixing : The asphalt cement shall be preheated to within the range of 350 to 450 degrees F. The asphalt-rubber blend for the master batch shall be preblended in appropriate preblending equipment as specified by the Supplier prior to introduction of the master batch into the distributor. Addition of asphalt cement and diluent into the distributor to provide the specified formula shall be as directed by the Supplier. The percentage of rubber shall be 20 to 24 weight percent of the total asphalt-rubber mixture (including diluent). Mixing and recirculation

Dsk RDP 16 (85-1013)

shall continue until the consistency of the mixture approaches that of a semi-fluid material (i.e., reaction is complete). At the lower temperature, it will require approximately 30 minutes for the reaction to take place after the start of the addition of rubber. At the higher temperature, the reaction will take place within approximately 5 minutes; therefore, the temperature used will depend on the type of application and the methods used by the Contractor. Viscosity of the asphalt-rubber shall be less than 4,000 centipoises at the time of application (ASTMD 2994 with the use of a Haake type viscometer allowed in lieu of a Brookfield Model LVF or LVT if desired). After reaching the proper consistency, application shall proceed immediately.

5.2.2 Adjustment to Spraying Viscosity With Diluent: After the full reaction described in Preparation of Binder, Method A, above has occurred, the mixture can be diluted with a kerosene type diluent. The amount of diluent used shall be less than 7.5 percent by volume of the hot asphalt-rubber composition as required for adjusting viscosity for spraying or better wetting of the cover aggregate. Temperature of the hot composition shall not exceed the kerosene initial boiling point at the time of adding the diluent.

5.3 Job Delays: Prior to preparation or use of asphalt-rubber (Prepared by either Method A or B), maximum holdover times due to job delays (time of application after completion of reaction) to be allowed will be agreed upon between the Contractor, Supplier, and the Contracting Officer. However, holdover times in excess of 16 hours will not be allowed at temperatures above 290 degrees F. Retempering by the addition of heat, asphalt, or diluents (kerosene/extender oil) will be allowed with approval of the Contracting Officer.

5.4 Seasonal and Weather Limitations: Placement of the asphalt-rubber surface treatment or interlayer shall be made only under the following conditions:

5.4.1 Ambient air temperature is above 60 degrees F and rising.

5.4.2 The surface to receive the asphalt-rubber is absolutely dry.

5.4.3 Wind conditions are such that a satisfactory membrane application can be achieved.

Dsk RDP 16 (85-1013)

5.5 Preparation of Surface: Prior to the hot asphalt-rubber application, the entire surface to be treated shall be cleaned as required by sweeping, blowing, and other methods until all dust, mud, clay lumps, and foreign material are removed entirely from the area. Patching may be required. No moisture should be present on the surface to receive the asphalt-rubber application. After cleaning and patching, the surface shall receive a tack coat if required by the Contracting Officer.

5.6 Application of Binder: The material shall be applied at a temperature of 375 to 425 degrees F for Method A and 290 to 350 degrees F for Method B at a rate specified by the Contracting Officer, generally 0.35 to 0.65 gallons per square yard. No shot shall be in excess of a length which can be immediately covered with aggregate. The Contractor is reminded that traffic in the adjacent lane must be protected from oil, stone, and sweepings. Application width may have to be adjusted to protect this traffic.

5.6.1 The application from the distributor shall be stopped when the tank contains less than 300 gallons of blended asphalt-rubber. At all startings, which shall include joints from preceeding applications, intersections, and at junctions with all pavements, etc., a proper junction shall be made to insure that the distributor nozzles are operating at full force when the application begins. Building paper or other suitable devices shall be used to receive the initial application from the nozzles before any material reaches the surface at the joint. The paper or device shall be removed immediately after use without spilling surplus material on the surface. During application of binder, the Contractor shall provide adequate protection to prevent marring or discoloration of pavement, structures, curbs, trees, etc., adjacent to the area being treated.

5.6.2 Longitudinal joints shall be reasonably true to line and parallel to the centerline. Overlap in the application of the binder shall be the minimum to assure complete coverage. Where any construction joint occurs, the treatment of the edges shall be blended so there are no gaps and the elevations are the same and free from ridges and depressions.

5.6.3 When the application of binder is less than the full width of treatment, the aggregates shall be spread only to within 8 inches of the edge of the next application until the binder is applied to the adjacent width. Between shots no substantial quantity of binder shall remain in the spray bars or nozzels.

Dsk RDP 16 (85-1013)

5.7 Application of Cover Aggregate : The application of aggregate shall follow immediately after the application of binder. The hot application of binder shall not be made further in advance of the spreading of the cover aggregate than can be covered immediately. The distributor and the aggregate spreader shall not be separated by more than 150 feet. Spreading or the aggregate shall be done directly from approved spreaders. Trucks and spreaders shall not drive on the uncovered binder.

5.7.1 The dry aggregate shall be spread uniformly to cover the binder with an amount of mineral aggregate such that no more than one layer of mineral aggregate is applied, this quantity is generally 25 to 40 pounds per square yard but will be as directed by the Contracting Officer. Any deficient areas shall be covered by additional material immediately.

5.7.2 The entire application of cover material shall be rolled as soon as possible after application. Rolling shall continue to be repeated as often as necessary to key cover material thoroughly into the binder over the entire surface. Pneumatic tire rollers (and steel wheel rollers, if directed by the Contracting Officer) shall be used in the sequence and combination which will provide the rolling pattern that results in the best adhesion of the aggregate to the binder and best surface qualities.

5.7.3 Subsequent to the initial application and rolling of cover aggregate the Contractor shall distribute, as many times as is deemed to be necessary, any loose cover aggregate over the surface tp absorb any free binder and cover any area deficient in cover aggregate. Immediately following each such distribution, the Contractor shall roll, with pneumatic rollers, the entire surface treatment or membrane interlayer until the maximum amount of aggregate is embedded in the binder. Such rolling in each case shall not be less than one complete coverage or as many additional coverages as is deemed necessary to properly embed and seat the aggregate. All such rolling shall be performed while the temperature is favorable for seating the aggregate into the binder.

5.7.4 In no case shall there be less than 3 complete coverages with pneumatic tired rollers of the entire surface of the treatment after initial placement.

5.7.5 When the Contracting Officer has determined that the maximum amount of cover aggregate has been embedded, the Contractor shall sweep or otherwise remove all loose material from the entire surface at such time and in such a manner as will not displace any embedded aggregate

Dsk RDP 16 (85-1013)

5.7.6 The completed asphalt-rubber surface treatment or interlayer shall be allowed to cure for a minimum period as directed by the Contracting Officer prior to paving any final overlays. Traffic will not be permitted on the asphalt-rubber surface treatment or interlayer until it has cured and the embedded cover aggregates are tightly bound into the surface such that they will not be dislodged by traffic.

6. METHOD OF MEASUREMENT : The asphalt-rubber surface treatment or interlayer will be measured by the number of square yards of compacted material in place.

7. BASIS OF PAYMENT : The unit price bid per square yard shall include the cost of furnishing all material, all labor and equipment necessary to complete the work. Payment for patching material and tack coat will be made under the appropriate bid items.

SECTION D-3

POLYMER MODIFIED ASPHALT-RUBBER SURFACE TREATMENT OR INTERLAYER

1. APPLICABLE PUBLICATIONS
2. DESCRIPTION
3. MATERIALS
4. METHOD OF MEASUREMENT
5. BASIS OF PAYMENT

1. APPLICABLE PUBLICATIONS : The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

1.1 American Society for Testing and Materials ASTM) Publications:

D 36-76	Softening Point of Bitumen (Ring and Ball Apparatus)
D 113-79	Ductility of Bituminous Materials
D 3407-78	Joint Sealants, Hot-Poured, for Concrete and Asphalt Pavements

2. DESCRIPTION : This work involves placement of a polymer modified asphalt-rubber treatment on a prepared pavement surface in accordance with the plans and other specifications.

2.1 This specification incorporates all sections of the specification ASPHALT-RUBBER SURFACE TREATMENT OR INTERLAYER (SECTION D-2) with modifications and amendments that follow.

3. MATERIALS : Materials will comply with the requirements of the above referenced specification, Method B, with the following modifications:

Dsk RDP 16 (85-1013)

3.1 Composition: The composition of the mixture shall be as follows: (Weight percent of the mixture).

Asphalt Cement	80 ± 1 percent
Ground Vulcanized Rubber	17 ± 1 percent
Polymer Modifier	3 ± 0.5 percent *

* The polymer modifier additive shall be as selected by the Supplier of the asphalt-rubber to provide the required mixture properties with approval of the Contracting Officer.

3.2 The modified asphalt-rubber when mixed and reacted at 350 degrees F for 1 hour shall have the following properties:

Properties	Limits	Test Method
Viscosity, 350 degrees F, centipoises	1500-4000	**
Softening Point, degrees F	140 min	ASTM D 36
Ductility, 77 degrees F, 5 cm./min., centimeters	20 min	ASTM D 113
Ductility, 39.2 degrees F, 1 cm./min., centimeters	15 min	ASTM D 113
Resilience, 77 degrees F, percent	15 min	ASTM D 3407

** Haake Rotational Viscometer (5.2.1, Referenced Specification).

3.3 Certification and Submittals: Prior to application, the Contractor shall submit certification of specification compliance for all materials to be used in the work. The Contracting Officer reserves the right to sample and test any materials in the work. Certification shall be submitted concerning the design of the modified asphalt-rubber blend as folows:

3.3.1 The Contractor shall submit certifications that the modified asphalt cement is compatible with the rubber. New certifications will be required if the asphalt cement lot or rubber source is changed.

Dsk RDP 16 (85-1013)

3.3.2 The Contractor shall submit information that shows, to the satisfaction of the Contracting Officer, that the modified asphalt-rubber and aggregate combination proposed for the project will not be subject to water stripping in the environmental exposure of the project.

4. METHOD OF MEASUREMENT : The modified asphalt-rubber surface treatment or interlayer will be measured by the number of square yards of compacted material in place.

5. BASIS OF PAYMENT : The unit price bid per square yard shall include the cost of furnishing all material, all labor and equipment necessary to complete the work. Payment for patching material and tack coat will be made under the appropriate bid items.

Dsk RDP 16 (85-1013)

SPECIAL PROVISION FOR ASPHALT-RUBBER AND MODIFIED ASPHALT-RUBBER SURFACE TREATMENTS AND INTERLAYERS

1. SPECIFICATION AFFECTED : Section D-2 , ASPHALT-RUBBER SURFACE TREATMENT OR INTERLAYER and Section D-2, POLYMER MODIFIED ASPHALT-RUBBER SURFACE TREATMENT OR INTERLAYER.

2. AFFECTED SECTION : 3.5.3 (Gradation). The specification shall be superseeded to read, "Gradation for this project shall be developed by the Contracting Officer and provided to the Contractor at least 30 days prior to placement of the asphalt-rubber or polymer modified asphalt-rubber".

- END -

Dsk RDP 16 (85-1013)

SECTION D-4

RUBBER FILLED ASPHALT CONCRETE

1 APPLICABLE PUBLICATIONS
2. GENERAL
3. JOB-MIX FORMULA
4. GRANULATED RUBBER
5. AGGREGATES
6. MINERAL FILLER
7. ASPHALT
8. CONSTRUCTION
9. MEASUREMENT AND PAYMENT

1. APPLICABLE PUBLICATIONS : The Publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

1.1 American Society for Testing and Materials (ASTM) Publications :

C 136-83 Sieve Analysis of Fine and Coarse Aggregates

D 2041-78 Theoretical Maximum Specific Gravity of Bituminous Paving Mixtures.

2. GENERAL : This work shall consist of furnishing and placing Rubber Filled Asphalt Concrete. This material is a rubber modified asphalt concrete which is a mixture of granulated rubber, asphalt cement, and a mineral aggregate, in accordance with these specifications and in reasonably close conformity with the lines, grades, thicknesses, and details shown on the plans or as established by the Contracting Officer.

2.1 Attention is directed to paragraph 5, AGGREGATES, of these specifications. The aggregate gradations are coarse and gap graded, which generally requires addition of a mineral filler to meet the gradation requirements. Rubber filled asphalt concrete is produced and placed with standard equipment. However, a system must be provided for introduction of the granulated rubber and required mineral filler. The system incorporated into the test sections of this project use a patented process and work will be under license agreement with:

All Seasons Surfacing Corporation
2281 116th Avenue N.E., Suite 2 (Telephone 206-454-3830)
Bellevue, Washington 98004-3015

Dsk RDP 16 (85-1013)

The Contractor will be responsible for aquiring all licence agreements for the use of this material for this project.

3. JOB-MIX FORMULA (JMF): After a representative quantity of aggregate has been produced and not less than 15 calendar days before production of the rubber filled asphalt concrete mixture begins, the Contractor shall submit to the Contracting Officer a proposed job-mix formula for approval. Representative samples of the stockpiled aggregates, asphalt, and rubber shall be taken and a final job-mix formula established by the Contracting Officer, based on laboratory design procedures approved by the licensor. Note that conventional mixture design procedures have not been found effective for the design of rubber filled asphalt concretes. The mixture design procedure for developing the job-mix formula will require approval of the Contracting Officer.

3.1 The job-mix formula shall include definite single values for:

A. The percentage of aggregate passing each specified sieve based on the dry weight of the total aggregate.

B. The percentage of asphalt to be added based on the total weight of mixture of rubber filled asphalt concrete.

C. The granulated rubber percentage shall be 3 percent based on the total weight of mixture of rubber filled asphalt concrete.

3.2 In addition to the aggregate sample(s) furnished above, the Contractor shall furnish the Contracting Officer with 1 gallon of the proposed asphalt cement and 10 pounds of the granulated rubber meeting the requirements of the following paragraphs.

3.3 Should a change of any materials be found necessary, a new job-mix formula will be required to be established in the same manner as described previously.

Dsk RDP 16 (85-1013)

3.4 All rubber filled asphalt concrete mixture furnished shall conform to the job-mix formula within the following range of tolerances:

Sieve Size (ASTM C 136)	Percent Passing
3/8 or 1/4 in.	JMF ± 6
No. 10 or No. 30	JMF ± 4
No. 200	JMF ± 0.5

Other Constituents	Range
Asphalt Cement	JMF ± 0.4 percent
Granulated Rubber	JMF ± 0.15 percent *

* Not determinable by conventional extraction testing

4. GRANULATED RUBBER : The granulated rubber shall be ground from whole passenger car or truck tires only. Heavy equipment tires or other non-automotive rubber shall not be used.

4.1 The rubber shall be cubical or thread-shaped and individual rubber particles, irrespective of diameter, shall not be greater in length than 5/16 inch. The granulated rubber shall conform to the following gradation requirements (ASTM C 136) :

Sieve Size	Percent Passing
1/4 in.	100
No. 4	76-100
No. 10	28-42
No. 20	16-24

4.2 Maximum allowable moisture content is 2 percent by weight of rubber.

Dsk RDP 16 (85-1013)

4.3 The Contractor shall furnish written certification of compliance with these specifications. In addition, each delivery shall be sampled at the rate of not less than 1 sample for each 20 tons of rubber and a dry sieve analysis performed to insure that the rubber granules meet gradation and size requirements. The sampling and testing must be completed and the rubber approved for use by the Contracting Officer before any delivery is incorporated into the rubber filled asphalt concrete.

5. AGGREGATES : Aggregates shall conform to the requirements in Section 3A, BITUMINOUS INTERMEDIATE AND WEARING COURSES FOR AIRFIELDS, HELIPORTS, AND HEAVY DUTY PAVEMENTS (CENTRAL-PLANT HOT-MIX).

5.1 Gradation Requirements (ASTM C 136)

	Percent Passing		
Sieve Size	Gradation 8	Gradation 12	Gradation 16
3/4"			100
5/8"		100	--
3/8"	100	60-80	50-62
1/4"	60-80	30-44	30-44
No. 10	23-38	20-32	20-32
No. 30	15-27	13-25	12-23
No 200	8-12	8-12	7-11

5.1.1 The rubber filled asphalt concrete must be gap graded to allow space for the rubber granules. For gradation 12 and 16 mixtures, this gap grade is defined by restricting the amount of aggregate passing the 1/4 inch sieve and retained on the No. 10 sieve to be 12 percent plus or minus 4 percent.

5.2 Before being fed to the dryer, the aggregate shall be separated into 2 or more sizes and stored separately. Sizing of the separated material shall be with the approval of the Contracting Officer. In placing aggregate into storage or in moving from storage to cold feed bins, any method that causes segregation, degradation, or the combining of materials of different gradings shall not be permitted. Any segregated, degraded, or contaminated material shall be rescreened or wasted

Dsk RDP 16 (85-1013)

6. MINERAL FILLER : A mineral filler is usually required to meet the minus No. 200 gradation requirements. The Contractor shall submit a representative sample of the mineral filler material to the Contracting Officer for approval and use in establishing the final job-mix formula. The plant shall be equipped to feed the mineral filler into the mixer with a precision of plus or minus 0.5 percent of the job-mix formula requirement.

7. ASPHALT : Asphalt type and grade shall be the same material specified in Section 3A, BITUMINOUS INTERMEDIATE AND WEARING COURSES FOR AIRFIELDS, HELIPORTS, AND HEAVY DUTY PAVEMENTS (CENTRAL-PLANT HOT-MIX).

7.1 The asphalt content (percent by total weight of rubber filled asphalt concrete) shall be within the following ranges :

Gradation 8	Gradation 12	Gradation 16
8.0 - 9.5	7.5 - 9.0	7.5 - 9.0

Actual asphalt content will be determined by the mixture design.

8. CONSTRUCTION :

8.1 Bituminous Mixing Plants : Mixing plants shall conform to the standard requirements found in Section 3A, BITUMINOUS INTERMEDIATE AND WEARING COURSES FOR AIRFIELDS, HELIPORTS, AND HEAVY DUTY PAVEMENTS (CENTRAL-PLANT HOT-MIX), except that the following shall be added :

8.1.1 Requirements for Batch Plants : The amount of granulated rubber incorporated into the rubber filled asphalt concrete shall be determined by weighing on springless dial scales, or by a method which uniformly feeds the mixer within plus or minus 0.15 percent of the required amount indicated in paragraph JOB-MIX FORMULA. Bags of granulated rubber may be used for proportioning provided the batch size is adjusted to use the entire bag of rubber. No partial bags will be allowed.

8.1.2 Requirements for Drum Mixing Plants : Granulated rubber introduced into the mixer shall be drawn from storage bins by a continuous mechanical feeder which will uniformly feed the mixer within plus or minus 0.15 percent of the required amount indicated in paragraph JOB-MIX FORMULA. The continuous feed system shall have a ready means of

Dsk RDP 16 (85-1013)

accurately calibrating the system. A means satisfactory to the Contracting Officer shall be provided to insure positive interlocking control between the flow of the granulated rubber and aggregates introduced into the rubber filled asphalt concrete. The plant shall be equipped with a heat shield or other means satisfactory to the Contracting Officer to prevent direct contact of the open flame and rubber.

8.2 Mixing: The Contractor shall prepare a work plan describing the planned procedures for mixing and placing the material. The plan shall include such details as the method of introducing the rubber granules into the mixture, mixing times, temperatures, and other equipment for production of the rubber filled asphalt concrete.

8.2.1 The plant shall be calibrated to produce the required composition of asphalt, rubber, aggregate, and mineral filler. Aggregate samples shall be taken in a manner satisfactory to the Contracting Officer to verify that the mixture is within the combined aggregate gradation specifications before beginning job-mix production.

8.2.2 Standard mixing procedures as found in Section 3A, BITUMINOUS INTERMEDIATE AND WEARING COURSES FOR AIRFIELDS, HELIPORTS, AND HEAVY-DUTY PAVEMENTS (CENTRAL-PLANT HOT-MIX) shall apply except as follows:

8.2.2.1 For batch plants, aggregates and granulated rubber shall be combined and mixed thoroughly for a minimum of 15 seconds prior to the introduction of asphalt. The asphalt, aggregates, and rubber granules shall be mixed so as to achieve a uniform distribution of all materials and coating of the aggregate and granulated rubber

8.2.2.2 The completed mixture shall conform to the job-mix formula within the requirements of paragraph JOB-MIX FORMUA. If the mixture is outside the tolerance limits for 2 consecutive samples, a plant and/or aggregate adjustment must be made to bring the mixture within the specified tolerance limits.

8.2.2.3 The temperature at mixing shall be between 325 and 375 degrees F. The temperature of the mixture at discharge shall be above 300 degrees F for both batch and drum mixing plants

Dsk RDP 16 (85-1013)

8.3 Hauling, Spreading, and Finishing:

8.3.1 The standard requirements of Section 3A, BITUMINOUS INTERMEDIATE AND WEARING COURSES FOR AIRPORTS, HELIPORTS, AND HEAVY-DUTY PAVEMENTS (CENTRAL-PLANT HOT-MIX) shall apply. When directed by the Contracting Officer, the mixture shall be covered with appropriate means to prevent rapid cooling of the mixture.

8.3.2 The mixture shall be placed at temperatures of not less than 300 degrees F when measured at the paving machine. Maximum compacted lift thickness shall be 2 inches.

8.3.3 A tack coat shall be applied at a rate of 0.06 to 0.08 gallons per square yard of residual asphalt in accordance with the Section TACK COAT.

8.3.4 The mixture shall be laid upon a surface approved by the Contracting Officer, spread, and struck to grade with a self-propelled asphalt paver conforming to the requirements of Section 3A, BITUMINOUS INTERMEDIATE AND WEARING COURSES FOR AIRPORTS, HELIPORTS, AND HEAVY-DUTY PAVEMENTS (CENTRAL-PLANT HOT-MIX). The mixture shall not be placed when it is raining or on a wet surface, or when the average ground temperature is less than 45 degrees F or when the Contracting Officer determines that weather conditions prevent proper handling or finishing. Where hand placement or raking is required, it shall be done immediately because the mixture becomes stiff and difficult to rake at lowered temperatures. If the mixture is produced by more than 1 asphalt plant, the material produced at each plant shall be placed by separate spreading and compacting equipment.

8.4 Compaction: Rollers and compaction procedures shall conform with the requirements of Section 3A, BITUMINOUS INTERMEDIATE AND WEARING COURSES FOR AIRFIELDS, HELIPORTS, AND HEAVY-DUTY PAVEMENTS (CENTRAL-PLANT HOT-MIX) with the following supplements:

8.4.1 Breakdown compaction shall begin immediately behind the paving machine. However, some delay may be required to prevent roller pickup. The roller drums must be kept well watered and a wetting agent may be necessary to decrease roller pickup.

8.4.2 Breakdown compaction shall be accomplished using a 10 to 12 ton vibrating or static steel wheel roller An 8 to 10 ton tandem steel roller shall be used for finish rolling. Finish rolling of the mat shall continue

until elastic movement under the roller is no longer observed.

8.4.3 Rolling procedures shall be established with a control strip to determine equipment and number of coverages necessary to obtain required density. The target density, as a percentage of maximum theoretical density (ASTM D 2041) shall be 95 to 98 percent to provide 2 to 5 percent air voids.

9. MEASUREMENT AND PAYMENT : Measurement of rubber filled asphalt concrete shall be by the ton, compacted in place, and will include the granulated rubber, aggregates, mineral filler, asphalt, and other components in the mixture.

9.1 The contract unit price per ton for rubber filled asphalt concrete shall be full compensation for furnishing all labor, equipment, materials, supplies, and royalties or licences required for the construction and placement of this material as specified.

Dsk RDP 16 (85-1013)

SECTION D-5

POLYPROPYLENE PAVEMENT REINFORCING FABRIC

1. APPLICABLE PUBLICATIONS
2. GENERAL
3. POLYPROPYLENE PAVEMENT REINFORCING FABRIC
4. ASPHALT SEALANT OR BINDER
5. FABRIC HANDLING EQUIPMENT
6. ASPHALT DISTRIBUTOR
7. CONSTRUCTION
8. MEASUREMENT AND PAYMENT

1. APPLICABLE DOCUMENTS : The publications listed below form a part of this specificati^n to the extent referenced. The publications are referred to in the text by basic designation only.

1.1 American Society for Testing and Materials (ASTM) Publications :

D 1682-64 Test Methods for Breaking Load and Elongation of Textile Fabrics

1.2 American Association of State Highway and Transportation Officials (AASHTO) Publications :

M 20-70 Penetration Graded Asphalt Cement

M 226-80 Viscosity Graded Asphalt Cement

2. GENERAL : This work shall consist of furnishing and placing a polypropylene pavement reinforcing fabric. This material and an accompanying asphalt sealant binder is to be placed in accordance with these specifications and in reasonably close conformity with the lines, grades, application rates, and details shown on the plans or as established by the Contracting Officer.

3. POLYPROPYLENE PAVEMENT REINFORCING FABRIC : Fabric shall be a 100 percent needle-punched non-woven polypropylene pavement reinforcing fabric which conforms to the following properties based on ASTM D 1682, Method D, Grab Method :

Dsk RDP 16 (85-1013)

Property	Minimum
Weight, ounces per square yard	3.8
Tensile Strength, pounds	90
Elongation-at-Break, percent	55
Asphalt Retention, gallons per square yard	0.20
Color	Black
Width, inches	75 or 150 (option)
Length per Roll, yards	120

4. ASPHALT SEALANT OR BINDER : Asphalt cement sealant or binder shall conform to AASHTO M 20 (TABLE 1) OR M 226 (TABLE 1 OR 3). Emulsified asphalts can be used with the approval of the Contracting Officer. Grades of asphalt will be determined by the Contracting Officer.

5. FABRIC HANDLING EQUIPMENT : Mechanical laydown equipment shall be capable of handling full rolls of fabric, and shall be capable of laying the fabric smoothly and without excessive wrinkles and/or folds. Specific requirements of the Supplier are included as a part of these specifications

6. ASPHALT DISTRIBUTOR : The distributor must be capable of spraying the asphalt binder at the prescribed temperature and application rate. It must be adjustable to give a uniform spray pattern over the entire width of application. A hydrostatic distributor is preferred. No drilling or skipping is permitted. As directed by the Contracting Officer, preliminary test applications may be required at an off-site area to insure proper distributor and operator performance.

7. CONSTRUCTION :

7.1 Surface Preparation : The surface to receive the polypropylene pavement reinforcing fabric must be free of dirt, water, and vegetation. Cracks or joints between 1/8 and 1/4 inch will be filled with a crack filler approved by the Contracting Officer. Larger cracks, joints, or holes are to be repaired with an approved hot ot cold asphalt mixture prior to placement of the polypropylene pavement reinforcing fabric. Leveling courses are a separate item.

Dsk RDP 16 (85-1013)

7.2 Application of Asphalt Sealant or Binder : The asphalt sealant or binder must be uniformly applied at the rate specified by the Contracting Officer. Quantity specified will vary with porosity of the underlying substrate, but in most cases, will be in the range of 0.25 to 0.30 gallons per square yard residual asphalt. Application must be by distributor as previously specified. Temperature of the asphalt sealant or binder must be sufficiently high to permit a uniform spray pattern. For asphalt cement, the minimum spray temperature is 300 degrees F. For emulsified asphalts, the minimum spray temperature shall conform to the recommendations of the emulsion manufacturer. If emulsified asphalt is used as the binder or sealant, the emulsion must be cured as per recommendations of the fabric Supplier prior to placing the polypropylene pavement reinforcing fabric.

7.3 Fabric Placement : The fabric shall be placed into the asphalt binder or sealant with a minimum of wrinkles. Brooming may be required to maximize fabric contact with the underlying substrate or surface. As directed by the Contracting Officer, if fabric folds exist, the fabric shall be slit and allowed to lay flat. Additional binder may be required to satisfy the double layer. All joints should overlap adjacent fabric by 2 to 6 inches. Transverse joints should be shingled in the direction of paving to prevent edge pickup by the paver. Paving operations should follow directly behind fabric placement under direction of the Contracting Officer. Removal and replacement of polypropylene pavement reinforcing fabric that is damaged for any reason after placement is the responsibility of the Contractor.

8. MEASUREMENT AND PAYMENT : Measurement of polypropylene pavement reinforcing fabric shall be by the square yard, in place, and will include polypropylene pavement reinforcing fabric and asphalt sealant or binder.

8.1 The contract unit price per square yard for polypropylene pavement reinforcing fabric shall be full compensation for furnishing all labor, equipment, materials, supplies, and royalties required for construction of this material as specified.

SECTION D-6

COLD MILLING

1. DESCRIPTION
2. EQUIPMENT
3. CONSTRUCTION REQUIREMENTS
4. METHOD OF MEASUREMENT
5. BASIS OF PAYMENT

1. DESCRIPTION: This work shall consist of cold milling of pavement in accordance with the plans and specifications and as may be directed by the Contracting Officer.

2. EQUIPMENT: The cold milling machine shall be an approved pavement profiler meeting the following minimum criteria:

A. Power operated.

B. Accurately establish profile grades with a tolerance of ± 1/8 inch by reference from the existing pavement surface or from an independent grade control with cross-slope elevation control.

C. Capable of cold milling the pavement.

D. Have an enclosed cutting area with an effective means of dust control.

3. CONSTRUCTION REQUIREMENTS:

3.1 The existing pavement surface shall be cold milled to the depth, width, and grades as shown on the plans or as established by the Contracting Officer.

3.2 Any adjustment to the plan depth and/or depth established by the Contracting Officer shall be adjusted in 1/4 inch increments. Said increments may be plus or minus and shall be effected whenever and wherever the Contracting Officer deems an adjustment in the work is necessary. The Contracting Officer shall be the sole judge as to said adjustments. The aforementioned adjustment(s) will be made to the established profile grades from the existing pavement surface or from an independent grade control with cross-slope elevation control.

Dsk RDP 16 (85-1013)

3.3 Excessive grooving by cold milling will not be permitted.

3.3.1 Excessive grooving for all intents and purposes of these specifications is defined as a variation in the milled surface in excess of 1/2 inch from the high point to the low point across the width of the cutting head of the milling machine. Measurement shall be made to the bottom of the groove from a straightedge or cutting stringline datum plane.

3.3.2 When excess grooving occurs, cold milling operations shall cease and the cold milling equipment corrected. Prior to resuming cold milling operations, all nonconforming work shall be corrected to the satisfaction of the Contracting Officer at no additional cost to the Government.

3.3.3 The pavement material eminating from the cold milling operation shall be removed and disposed of as directed by the Contracting Officer.

3.4 This project requires that all longitudinal and transverse surfaces (edges) be milled in such a manner that a slope or bevel of 3 inches vertically to 6 feet horizontally for 6 feet horizontally be prepared to allow passage of aircraft across the milled surface after milling is complete as part of this specification.

4.5 After milling, all loose material that could cause foreign object damage (FOD) shall be removed to the satisfaction of the Contracting Officer. Hand removal and brooming may be necessary.

4. METHOD OF MEASUREMENT : Cold milling of existing pavement surfaces will be measured by the square yard inch. A square yard inch is defined as one square yard by one inch deep for purposes of these specifications.

5. BASIS OF PAYMENT : The unit price bid per square yard inch shall be full compensation for removing of the cold milled pavement surface material and hauling said material a maximum of five miles for disposal and for furnishing all equipment, tools, labor, materials, and incidentals necessary to complete the work provided herein

Dsk RDP 16 (85-1013)

(The reverse of this page is blank.)

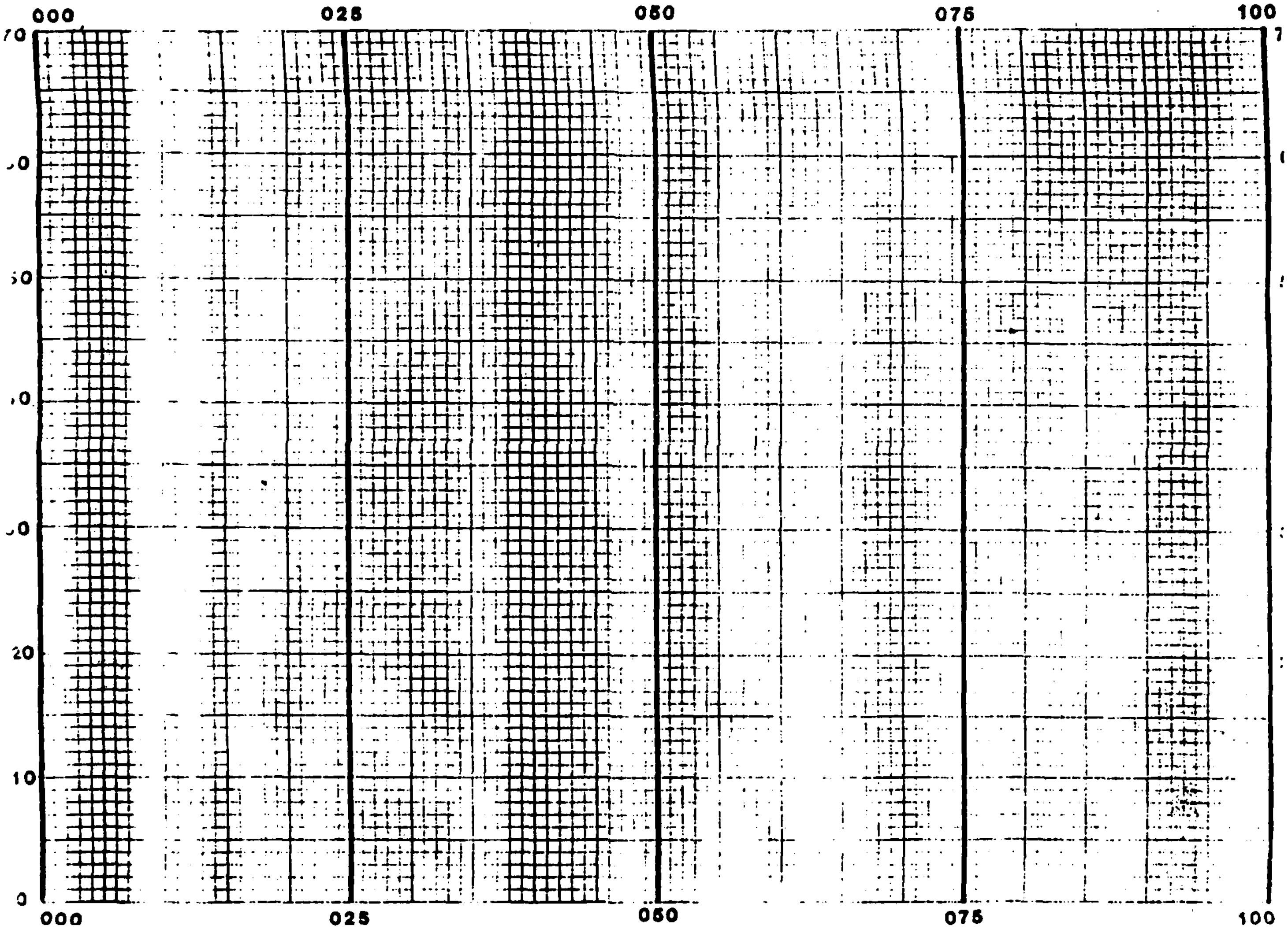
APPENDIX E

TYPICAL FIELD DATA SHEETS--PETERSON AFB

PETERSON AFB
CRACK SURVEY

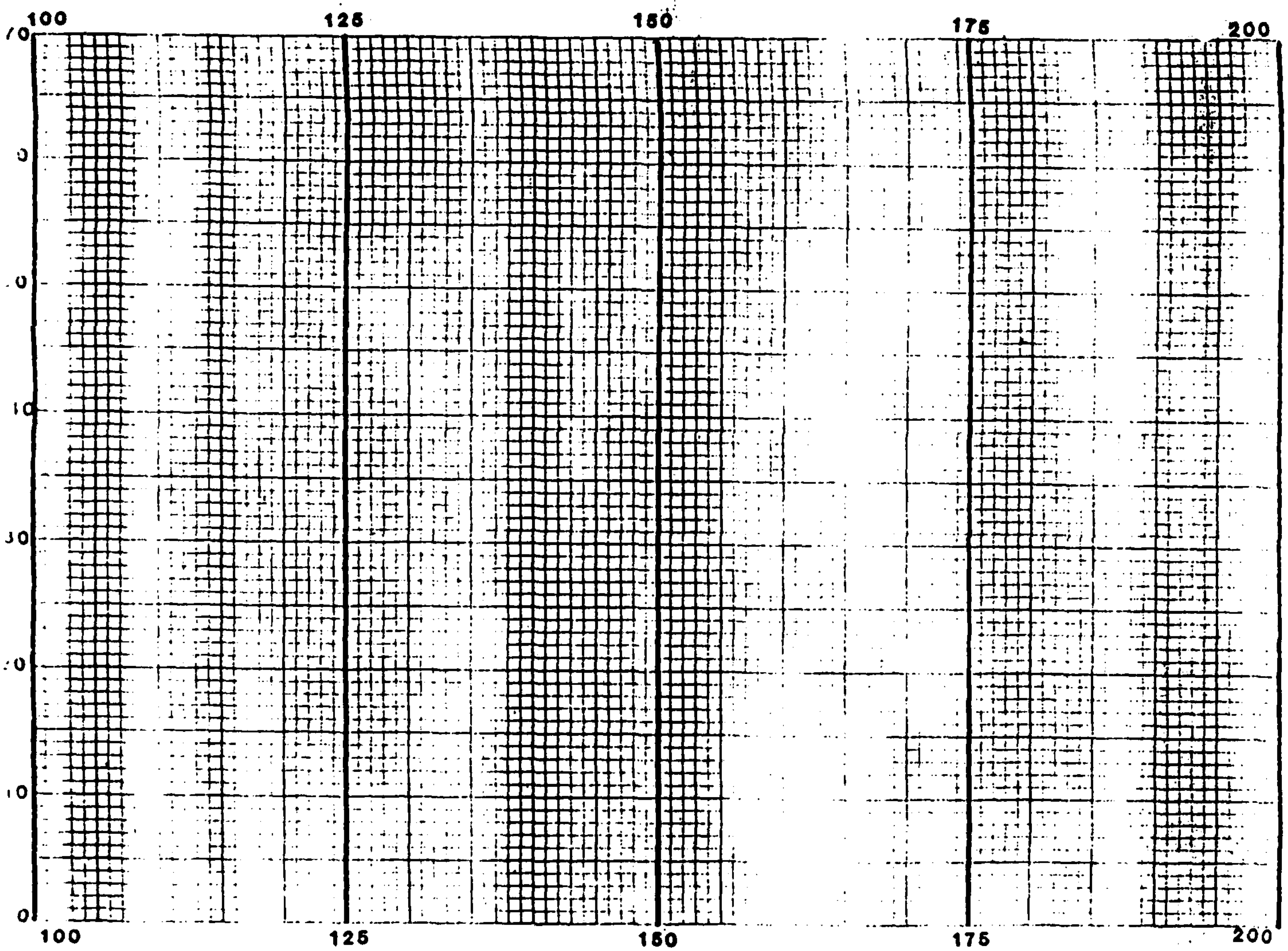
Stations 000 to 100
Section 1, Treatment E (Fabric)

Date: By:



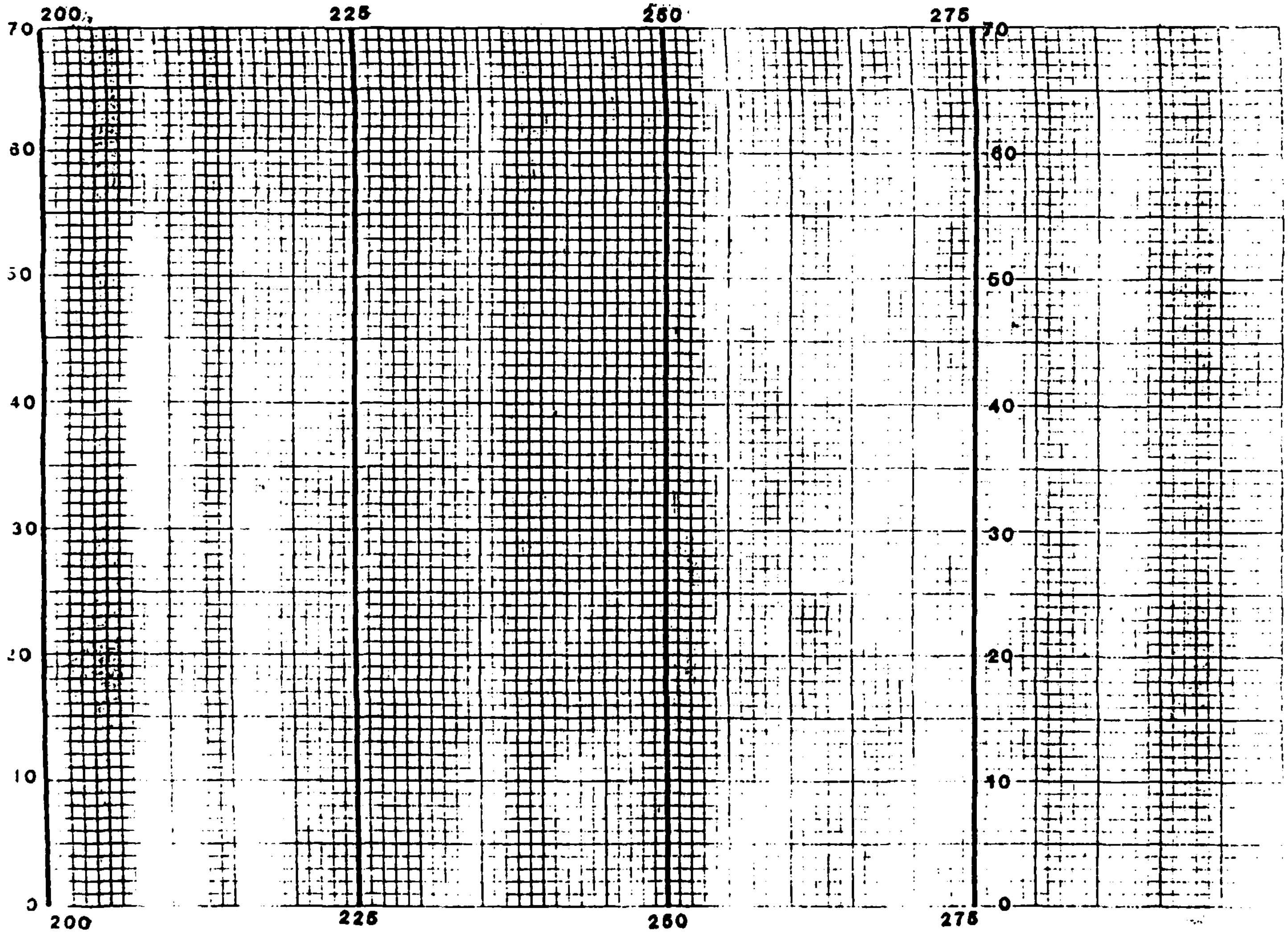
PETERSON AFB
CRACK SURVEY

Stations 100 to 200
Section 1, Treatment E (Fabric)
Date: By:



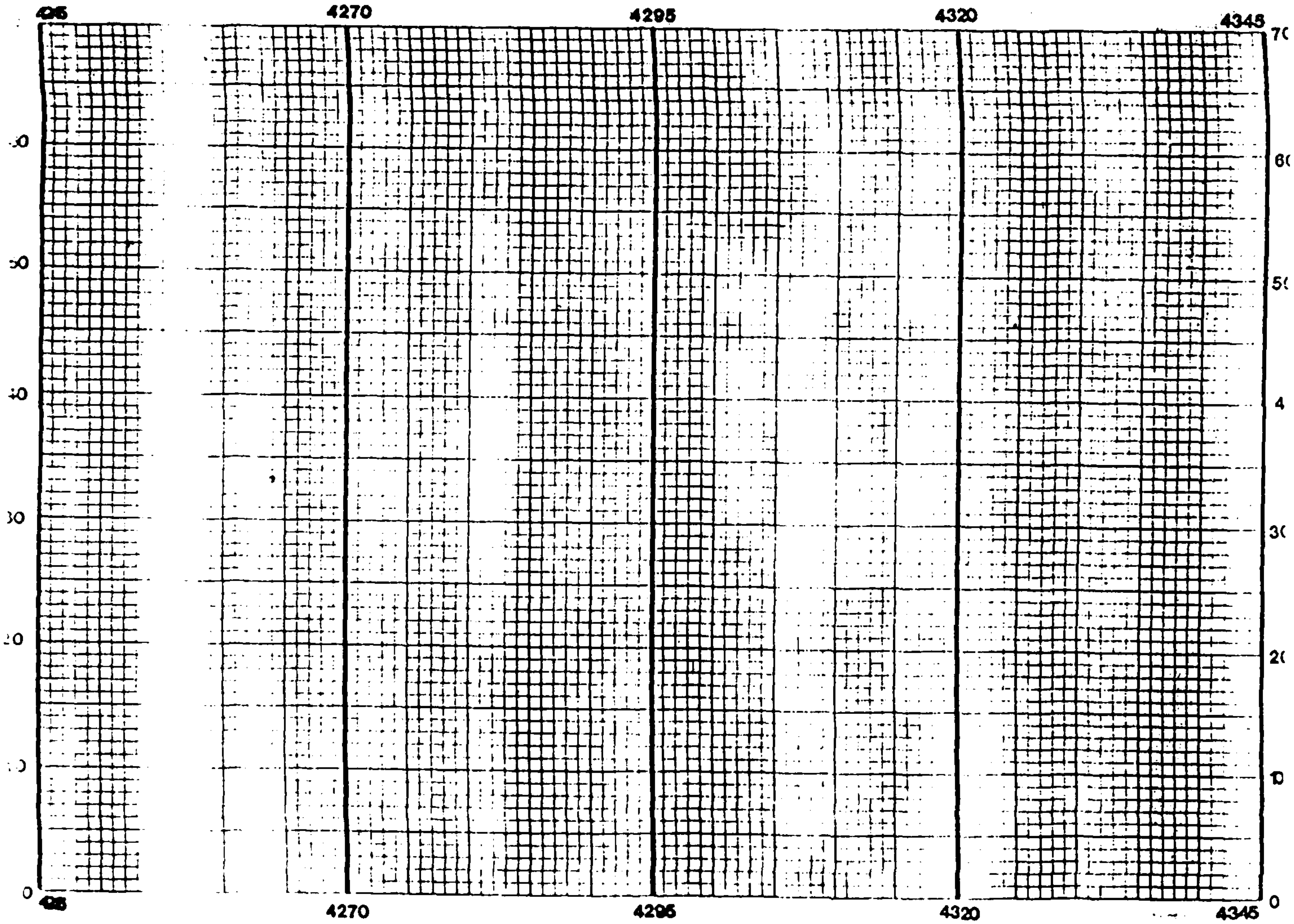
PETERSON AFB
CRACK SURVEY

Stations 200 to 275
Section 1, Treatment E (Fabric)
Date: By:



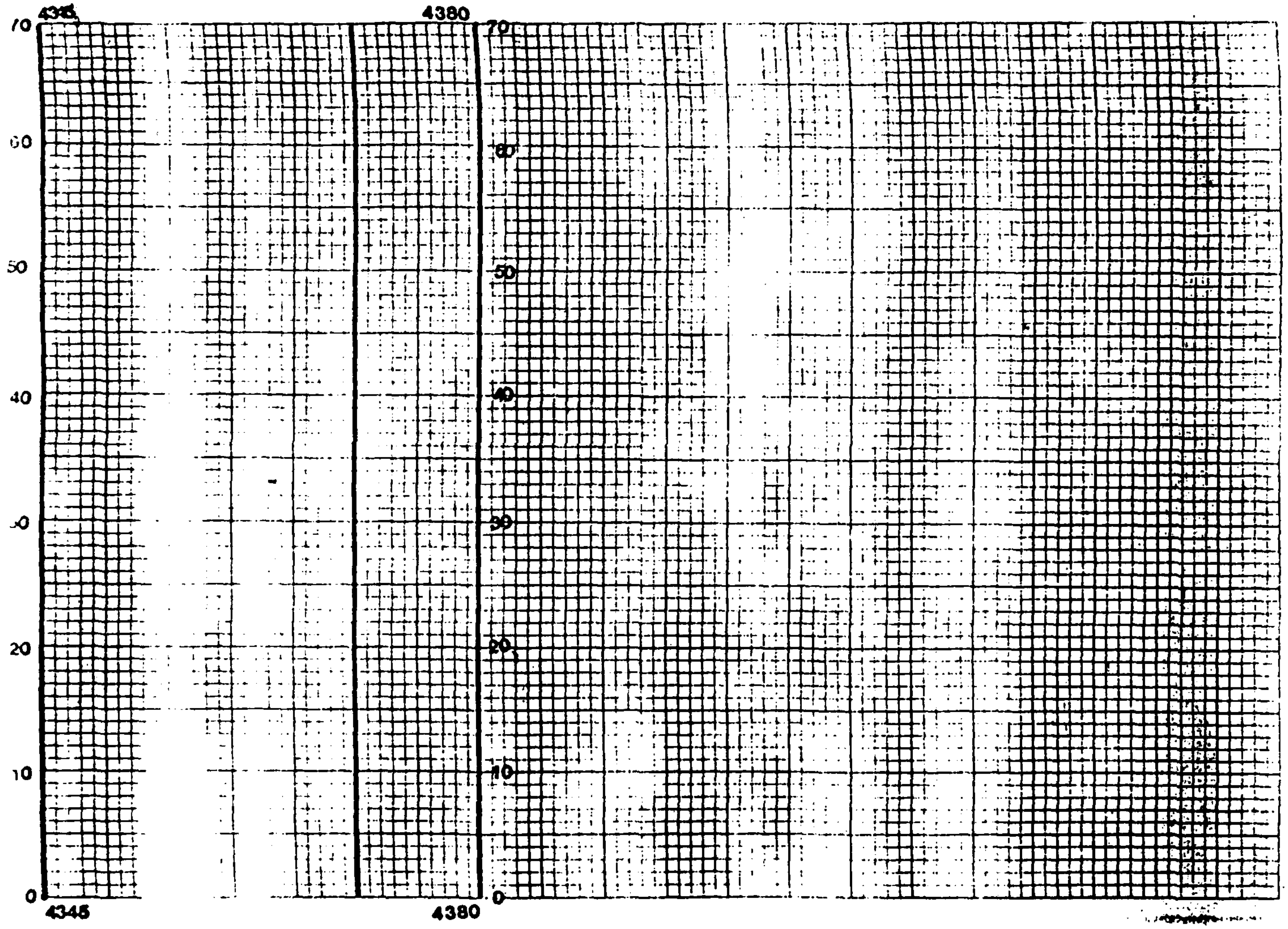
PETERSON AFB
CRACK SURVEY

Stations 4245 to 4345
Section 20, Treatment E (Fabric)
Date: By:



PETERSON AFB
CRACK SURVEY

Stations 4345 to 4380
Section 20 , Treatment E (Fabric)
Date By



APPENDIX F

CONSTRUCTION DATA--PETERSON AFB

TABLE F-1. PETERSON AFB CONSTRUCTION SEQUENCE

SECTION	STATION	TACK-COAT APPLIED DATE	INTERLAYER MATERIAL	INTERLAYER DATE PLACED	HOT MIX OVERLAY DATE	RUBBER ASPHALT CONCRETE	JOINTS SAWED DATE	
LARGE								
B	0+00- 2+75	9-26-85	AR	9-26-85	9-27-85			
C	2+75- 5+50	9-26-85	MAR	9-26-85	9-27-85			
E	5+50- 8+25	9-26-85	PETROMAT	10-7-85	10-7-85			
A	8+25-11+00	9-26-85	--	--	10-7-85			
D	11+00-13+75	9-26-85	--	--	--	10-12-85		
F	13+75-16+50	9-24-85	--	--	9-27-85		9-28-85	
F	16+50-19+25	9-24-85	--	--	9-27-85		9-28-85	
E	19+25-22+00	9-24-85	PETROMAT	9-25-85	9-27-85			
D	22+00-24+75	9-26-85	--	--	--	10-12-85		
B	24+75-27+50	9-25-85	AR	9-26-85	10-7-85			
A	27+50-30+25	9-25-85	--	--	10-7-85			
C	30+25-33+00	9-25-85	MAR	9-26-85	10-7-85			
SMALL								
B	33+00-34+35	9-25-85	AR	9-26-85	10-7-85			
A	34+35-35+70	9-25-85	--	--	10-7-85			
D	35+70-37+05	9-25-85	--	--	--	10-12-85		
E	37+05-38+40	9-24-85	PETROMAT	10-5-85	10-5-85			
C	38+40-39+75	9-24-85	MAR	9-25-85	10-5-85			
B	39+75-41+10	9-24-85	AR	9-25-85	10-5-85			
A	41+10-42+45	9-24-85	--	--	10-5-85			
E	42+45-43+80	9-24-85	PETROMAT	10-5-85	10-5-85			
C	43+80-45+15	9-24-85	MAR	9-25-85	10-5-85			
D	45+15-46+40	9-24-85	--	--	--	10-12-85		

TABLE F-2. ASPHALT-CONCRETE OVERLAY--APRON, TAXIWAY--PETERSON AFB

FIELD DATA						LABORATORY DATA					
DATE	LOCATION CORE SAMPLE			UNIT WEIGHT, lb/ft³	LABORATORY UNIT WEIGHT DENSITY, %	UNIT WEIGHT, lb/ft³	A.C., %	STABILITY, lb	STABILITY SPECIFICATIONS MINIMUM, lb	FLOW, 0.01 in	FLOW SPECIFICATIONS MAXIMUM, 0.01 in
	SECTION	STATION	LANE								
1985											
9-25	F	15+20	1	150.3	98.5	152.5	5.5	2560	1800	13	16
	F	17+40	1	151.1	99.1	152.5	5.5	2560	1800	13	16
	E	19+85	1	150.6	98.7	152.5	5.5	2560	1800	13	16
9-27	B	2+75	3	149.1	99.7	149.6	5.1	2750	1800	14	16
	C	3+18	3&4	145.0	96.9	149.6	5.1	2750	1800	14	16
	B	2+40	4&5	148.1	99.0	149.6	5.1	2750	1800	14	16
	F	15+00	5	147.4	97.3	151.5	5.25	2860	1800	13	16
	F	15+20	2	149.3	98.2	152.0	5.1	2740	1800	15	16
	F	15+90	3&4	144.5	95.1	152.0	5.1	2740	1800	15	16
	C	5+20	5	149.9	98.2	152.7	5.3	2620	1800	13	16
	F(Retest)	15+90	3&4	145.2	95.5	152.0	5.1	2740	1800	15	16
10-5	C	39+00	1	148.3	99.0	149.8	5.1	2770	1800	15	16
	C	44+03	3	147.5	98.5	149.7	5.1	2620	1800	12	16
	A	41+11	4	146.0	97.6	149.6	5.0	2750	1800	14	16
	C	39+15	6	147.4	99.1	148.7	5.5	2710	1800	14	16
	C	38+63	1&2	141.9	94.7	149.8	5.1	2770	1800	15	16
	C	44+10	3&4	144.0	96.2	149.7	5.1	2620	1800	12	16
	A	41+35	4&5	143.2	95.7	149.6	5.0	2750	1800	14	16
	C	38+62	5&6	143.2	96.3	148.6	5.5	2710	1800	14	16
10-7	C	31+00	1	148.2	99.5	149.0	5.4	2530	1800	14	16
	A	28+00	3	149.1	100.0	149.1	5.4	2725	1800	14	16
	C	31+00	6	147.3	98.0	150.3	5.2	2720	1800	12	16
	E	10+00	1	150.1	100.5	149.4	5.5	2340	1800	15	16
	A	30+15	1&2	143.8	96.5	149.0	5.4	2530	1800	14	16
	A	35+00	3&4	141.0	94.6	149.1	5.4	2725	1800	14	16
	C	30+85	4&5	143.9	96.0	150.3	5.2	2720	1800	12	16
	A	8+15	3&4	140.9	94.3	149.4	5.5	2340	1800	15	16

TABLE F-3. SIEVE ANALYSIS

SIEVE SIZE	SIEVE ANALYSIS-PER CENT PASSING - DATE OF TESTS									MIX DESIGN	SPECIFICATIONS
	9-25	9-27	9-27	9-27	9-27	10-5	10-5	10-5	10-5		
3/4	100.0	98.7	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	96-100
1/2	84.7	81.8	86.1	87.0	87.8	81.7	81.2	83.1	91.2	85.1	81.1-89.1
3/8	75.7	69.9	73.2	75.0	75.5	68.7	67.3	67.0	79.5	74.0	70.0-78.0
4	63.7	52.9	56.3	53.6	54.1	52.0	46.4	47.7	52.2	61.3	57.3-65.3
8	50.4	37.3	39.7	37.7	37.2	37.3	32.8	34.0	46.1	39.1	36.1-42.1
16	36.9	26.5	28.1	26.7	26.2	26.8	23.2	24.3	24.7	22.2	19.2-25.2
30	27.3	19.8	20.2	19.7	19.6	19.5	16.9	17.6	17.6	15.4	12.4-18.4
50	20.5	15.3	14.9	14.5	15.0	14.6	13.0	13.3	13.3	12.4	9.4-15.4
100	15.6	12.2	10.8	10.6	11.5	16.6	10.5	10.5	10.5	11.5	10.5-12.5
200	12.4	9.7	8.4	6.0	9.1	9.3	8.6	8.4	8.4	8.4	7.4-9.4

TABLE F-3. SIEVE ANALYSIS (Concluded)

SIEVE SIZE	SIEVE ANALYSIS-PER CENT PASSING - DATE OF TESTS									MIX DESIGN	SPECIFICATIONS
	10-7	10-7	10-7	10-7							
3/4	100.0	100.0	100.0	100.0						100.0	96-100
1/2	87.6	89.0	85.4	87.4						85.1	81.1-89.1
3/8	75.3	74.1	71.3	77.1						74.0	70.0-78.0
4	52.7	51.6	54.3	56.3						61.3	57.3-65.3
8	37.1	36.4	37.8	37.4						39.1	36.1-42.1
16	25.9	25.6	25.2	25.5						22.2	19.2-25.2
30	18.9	18.5	17.4	19.1						15.4	12.4-18.4
50	14.3	13.7	12.3	13.4						12.4	9.4-15.4
100	11.4	10.7	9.3	10.6						11.5	10.5-12.5
200	9.3	8.5	7.4	8.5						8.4	7.4-9.4

TABLE F-4. RUBBER-FILLED ASPHALT-CONCRETE DATA

LABORATORY DATA										FIELD DATA - CORES			
SIEVE SIZE	DATE - SIEVE ANALYSIS COMPOSITE SAMPLE PER CENT PASSING				MIX DESIGN	SPECIFI-CATIONS	ASPHALT CONTENT	ASPHALT CONTENT SPECIFI-CATIONS	UNIT WT. MARSHALL	STATION	LANE	UNIT WEIGHT	MARSHALL COMPACTION
	10/12	10/12	10/12	10/12			%		PCF			PCF	%
3/4	100.0	100.0	100.0	100.0	100.0	100.0	7.75	7.5-9.0	144.8	13+00	2	141.2	97.5
3/8	45.5	61.8	51.5	49.0	59.6	50-62				12+64	3	139.7	96.5
1/4	35.4	50.8	38.5	34.6	40.1	30-44				24+23	3	141.7	97.9
10	26.3	29.9	22.9	16.9	24.3	20-32				36+36	5	138.5	95.6
30	17.2	17.4	15.9	10.8	13.4	12-23				45+86	4	138.0	95.3
											JOINTS		
200	9.1	9.2	10.4	6.7	8.4					11+92	2&3	141.4	97.7
										24+15	4&5	136.0	93.9
										36+40	3&4	138.7	95.8
										45+62	1&2	138.4	95.6

END
DTIC
8-86